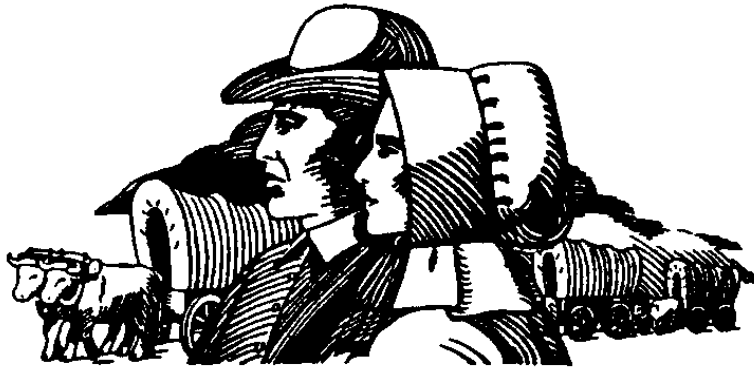


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Oregon City, Oregon Hazard Mitigation Plan



CITY OF OREGON CITY

Robert Olson Associates, Inc.
French & Associates, Ltd.

October 1998

This plan was prepared by Robert Olson Associates, Inc., Sacramento, California, and French & Associates, Ltd., Park Forest, Illinois, with funding from Metro, the regional government for the Portland, Oregon, metropolitan area. For more information on hazard mitigation planning in the Portland Metro area, contact:

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Oregon City
Hazard Mitigation Plan

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Chapter 1. Introduction

1.1. Background

The City of Oregon City has benefitted from its natural setting. Its location on the Willamette and Clackamas Rivers helped it become the first incorporated city in Oregon and built its early economy on river trade. In the shadow of Mount Hood and surrounded by great forests, it is a very scenic settlement. A strong community was built on the “solid ground” of the valleys and hillsides.

These same natural features also present a variety of hazards to the City. The natural forces that created Mount Hood and the Cascade Range also cause earthquakes and volcanos. Heavy precipitation can result in floods in the valleys and landslides on the hillsides. Weather extremes of cold, wind, heat and drought cause winter storms and make conditions ripe for wildfires.

It is a well-accepted tenet that natural activities, such as rain, cold and heat are by themselves beneficial or, at worst, benign. They are part of the natural order. Floods replenish floodplains with nutrients and recharge aquifers and wildfires help preserve and restore appropriate plant life. These “hazards” do not cause problems except where humans are affected.

Disasters occur when natural hazards affect human development, especially in urban areas. More and more, we are realizing the results of urbanizing hazardous areas, such as floodplains and steep hillsides, and construction practices that do not account for natural activities, such as earthquakes, erosion, wind and wildfires.

This lesson was most recently brought home to Oregon City’s residents in February and November 1996 when floods and landslides caused extensive damage to homes, businesses, and streets.

1.2. Hazard mitigation

There are two approaches to dealing with natural hazards: manage the hazard and manage the development. In some cases, especially when it affects existing development, managing the hazard may be more appropriate and/or more efficient. For example, drainage improvements can control small scale flooding and keep developed areas dry. Wildfires that threaten homes can be controlled with fire fighting techniques.

In other cases, it makes more sense to manage development. It is easier, less disruptive of the environment, and often cheaper to avoid high velocity floodplains and slide-prone hillsides than to build structures to control flooding or landslides. It is safer to construct earthquake-resistant buildings than to ignore the threat.

[This page reserved for Figure 1-1, general map of Oregon City.

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Together, these two approaches comprise the field of *hazard mitigation*. The Federal Emergency Management Agency defines mitigation as “sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects.”

There are a variety of mitigation strategies and measures that can manage the hazards and manage development. Some will work here while others won’t, depending on the hazards and the resources available to the City to implement the measures.

Determining what mitigation strategies and measures are best for an area is done through a planning process. During this process, the various hazards are inventoried, the full range of possible measures are reviewed, and the most appropriate and affordable ones are recommended for implementation.

Mitigation planning is conducted at all levels of government. At the Federal level, the Federal Emergency Management Agency has produced a *National Mitigation Strategy* to provide broad guidelines for national activities. At the State level, Oregon Emergency Management is preparing a comprehensive state hazard mitigation plan pursuant to Section 409 of the Stafford Act.

Metro is preparing a natural hazards mitigation plan that will set guidelines for regional and local activities for the Portland metropolitan area. As part of this effort, Metro funded this plan for Oregon City. It is both a local plan and a model for other communities in the Metro area. During this period, Clackamas County has been preparing its mitigation plan in coordination with the Metro and Oregon City efforts.

1.3. Planning procedures

This plan was prepared by a Community Planning Team which was appointed in March 1998. Team members included:

- " Jim Davis, Fire Chief, Chair
- " Dan Bradley, South Fork Water Board
- " Rich Carson, Director, Dept. of Community Development
- " Ken Dawson, Fire Dept.
- " Gordon Huiras, Police Dept.
- " Mike Levine, Oregon City Downtown Association
- " Henry Mackenroth, Dept. of Public Works - Street Engineer
- " Mike McGuire, Metro
- " Joe McKinney, Dept. of Public Works
- " Rick McClung, Director, Dept. of Public Works
- " Dick Newman, Oregon City School District
- " Lynda Orzen, Hillendale Neighborhood Association
- " Mary Palmer, Dept. of Community Development - Community Coordination
- " Stacey Sacher Goldstein, Dept. of Community Development - Planning
- " Jessica Schriever, Dept. of Community Development - GIS
- " Diane Sparks, Oregon City Chamber of Commerce
- " Gerry Uba, Metro
- " John Williams, Southend Neighborhood Association

The Team met in April, June and September of 1998 to review reports, studies, plans, personal experiences, and other information on the hazards facing the City and the City's vulnerability to them. It focused its work on seven hazards that have the greatest impact on Oregon City:

- " Flooding
- " Landslides
- " Earthquakes
- " Volcanic activity
- " Wind and ice storms
- " Wildland/urban interface fires
- " Hazardous materials

It is recognized that this list does not include every hazard or public safety threat that faces the City. Other hazards and threats, such as terrorism and war, are addressed in the City's Emergency Operations Plan and other public safety procedures. They are not included here because they are more remote and less conducive to mitigation than the seven selected.

The Community Planning Team examined the full range of mitigation alternatives, including those that manage the hazard and those that manage development. These are arranged under five general strategies:

- " *Structural projects* contain the hazard, such as a flood control reservoir or debris basin.
- " *Property protection* activities protect existing development.
- " *Emergency services* measures are taken during an event to minimize its impact.
- " *Prevention* activities keep problems from getting worse through management of new development.
- " *Public information* activities advise people about the hazards and ways to protect themselves and their property.

This plan is the result of that work. Chapter 2 reviews the hazards and their threats to life, safety and property. Chapter 3 includes the City's mitigation goals and objectives. Chapter 4 summarizes the mitigation alternatives that were reviewed. Those alternatives that will work in Oregon City were selected and recommended in Chapter 5, the Action Plan.

The Team's work was supported by Robert Olson Associates, Inc. and French & Associates, Ltd. Technical assistance was provided by several experts in hazard mitigation, including Clancy Philipsborn, Tom Tobin, Scott McAfee and Jim Russell.

Team members or the consultants met with or otherwise coordinated this work with many regional, state and federal agencies, including:

- " Federal agencies
 - U.S. Army Corps of Engineers
 - Federal Emergency Management Agency

- National Weather Service
- Natural Resources Conservation Service

- " State agencies
 - Oregon Emergency Management
 - Department of Geology and Mineral Industries
 - Department of Land Conservation and Development
 - Department of Water Resources, Dam Safety

- " Regional and local agencies
 - Metro, the regional planning agency for the Portland area.
 - Clackamas County Emergency Management
 - Clackamas County Community College, Environmental Learning Center

The draft of this plan was completed in September 1998. Its availability was publicized and copies were given to interested citizens. A public meeting was held on September 24 to explain the plan and receive comments on how it could be improved. Following the public meeting, the Team made appropriate changes and recommended that it be adopted by the City Commission.

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Chapter 2. The Hazards

This chapter presents summary data on the major natural hazards facing Oregon City. It references sources of more detailed information which would be helpful when planning specific projects.

2.1. Flooding

Source of the hazard: Flooding results when there is an excess amount of more rain or snowmelt. River channels, ditches and other watercourses can only carry so much water. When precipitation brings more water (or when there is a blockage in the watercourse), the surrounding land is flooded.

In this part of the country, flooding is most common during October through April when storms from the Pacific Ocean bring intense rainfall. Flooding can be aggravated when the rain is accompanied by snowmelt, frozen ground and high tides. It was a combination of these factors that produced the most recent disastrous floods in February and November 1996.

Oregon City is subject to two types of flooding: riverine and local drainage.

- " Riverine flooding occurs along three major streams:
 - the Willamette River (drainage area of 10,100 square miles)
 - the Clackamas River (drainage area of 937 square miles), and
 - Abernethy Creek (drainage area of 30 square miles)
- " Local drainage flooding occurs along the smaller creeks and drainageways. Local drainage flooding is more likely to result from heavy local storms.

Area affected: Riverine flooding: The areas subject to riverine flooding have been mapped by the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program (NFIP). The national and state flood mapping standard is the 100-year or base floodplain. The base floodplain for Oregon City is shown in Figure 2-1 at the end of this report.

Each of the three streams have regulatory floodways mapped. They are depicted on FEMA maps as relatively narrow areas on each side of the channels. Floodways are subject to special floodplain development regulations. On the Willamette River and Abernethy Creek, the floodways are generally confined within the high stream banks. On the Clackamas, it covers a somewhat larger area. In all three cases the floodways are so narrow that they are not shown on the map in Figure 2-1.

Local drainage: Local drainage problems occur throughout the City. There are three general types of problems:

- " High water tables, especially in the south part of the City, mean wet crawlspaces, yards and, sometimes, basements after local storms.
- " In some areas, the "lay of the land" means surface water doesn't drain quickly to a receiving stream or storm sewer.
- " Storm sewers and culverts may be too small to carry heavier flows.

These problems were inventoried in the City's 1988 *Drainage Master Plan*. That study identified 22 drainage areas in the City. Of the 59 major hydraulic structures inventoried, the report noted that 26 of them (44%) could not carry the five-year peak flow. "This indicates that overbank flooding problems occur frequently at some locations throughout the study area." [page ES-1]

Public Works staff reported several sites where local drainage facilities are taxed during high flows, especially where open ditches enter culverts or go underground into storm sewers. Surface flows into an undersized storm sewer results in flooding of several businesses near Washington and 7th "almost annually." Because these involve the City's sewer system, the City has assumed the cost of cleaning up after these floods.

Local drainage problems have been aggravated by property owners who do not realize the repercussions of their actions. Roadside ditches and swales between buildings are often filled by owners who want a flatter yard that is easier to mow. Some dump their yard clippings and other waste into the nearest ditch, adding to the debris that dam or plug the channel.

Threat to life and safety: Riverine flooding: Generally, floods kill people in one of two ways: when a flash flood hits an area with no warning or when people ignore basic safety precautions. The Clackamas and Willamette Rivers are not considered "flashy." Except in the case of a dam failure, warnings can be disseminated in time if upstream and watershed conditions are monitored.

"Flash" floods can occur on smaller streams like Abernethy Creek during or after a severe local storm. They can also happen on any of the streams following failure of an upstream dam. Sometimes a dam breach can occur on clear days, when no one is thinking of a flood hazard. The speed of onset, lack of advance warning, and depth of flooding make dam failures a deadly occurrence.

There are four major dams upstream of Oregon City on the Clackamas River: North Fork, Faraday, River Mill and Timothy. These are operated by Portland General Electric and are subject to the dam safety and warning requirements of the Federal Energy Regulatory Commission.

According to the Clackamas County emergency action plan, should the North Fork dam fail under a "probable maximum flood" (a worst case scenario where all four dams fail), Oregon City would be inundated by a wall of water 60 - 80 feet high in approximately an

hour and a half. This would be a severe threat to public health and safety. There are no major dams on Abernethy Creek and the Willamette River dams are far enough upstream and dispersed so that failures on these two streams would not be much worse than a regular flood.

Local drainage: Local drainage flooding may occur with little warning, the depths and velocities are usually not life threatening. However, shallow flooding can kill if safety precautions are not followed. More people are killed in their vehicles by floods than in any other location. Often, drivers ignore warning signs and barriers and try to drive across roads or bridges that are too deep or no longer there. Electrocution is another way people die during floods -- they forget to turn the power off when they go into a flooded building.

Additional threats to people are caused by contaminated water and damage to public health facilities. Flooding of hazardous materials sites and wastewater treatment plants results in polluted water that people may unknowingly walk in and that soaks into homes, restaurants and other businesses. A flood that shuts down a water treatment plant or breaks a water line creates a public health hazard for everyone in town. Loss of this essential service can result in weeks of disruption and exposure of the population to the health hazards that can follow the lack of safe drinking water.

Threat to property: There are 112 buildings in the areas mapped as subject to overbank flooding:

- 61 commercial and industrial buildings
- 27 government buildings (including 16 at the County complex)
- 20 residential buildings
- 4 Oregon Trail Center and visitor information center

Most of these buildings are located in the lowest part of the City, where the three streams converge. Smaller floods have been caused by obstructions and blocked culverts on Abernethy Creek. However, larger floods are actually caused by backwater when the Willamette and Clackamas Rivers flood. This floodprone area includes the following critical facilities:

- " The Clackamas County complex of offices and vehicle and equipment storage
- " The wastewater treatment plant that serves Oregon City, West Linn and Gladstone
- " An electrical power substation
- " The intake for the water treatment plant that serves Oregon City and West Linn
- " The solid waste transfer station
- " A Title III hazardous materials site (see Section 2.7)

The types of damage caused by a flood depend on the depth and velocity of the flood waters. Faster moving waters can wash buildings off their foundations and sweep cars downstream. However, most flood damage in Oregon City is caused by water soaking materials susceptible to damage, such as wood, insulation, wallboard, and fabric. This was the case for most of the areas flooded in 1996.

In addition to direct property damage, deep flooding can close roads and railroads. Floodwaters also erode soil, undercut bridges and soak landslide-prone hills, causing secondary disasters.

Floods are not clean and soaking leaves residues of silt, oil and chemicals that were in the floodwaters. The best way to clean many materials after a flood is to simply throw them away. This includes mattresses, baby toys, medicine, carpeting, insulation, upholstered furniture and other items that are too difficult to adequately clean.

Not all floodprone areas are subject to damage. Several valleys, such as the upper reaches of Abernethy Creek, are still in or near their natural state. Flooding of such areas causes no damage to human development and may help the riparian habitat. Newell Creek Canyon is the second largest natural forest in public ownership in the metropolitan area and is the subject of an important master planning effort to preserve it. As long as these floodplains are not developed, they won't have any serious overbank flood problems.

History: The main streets of Oregon City were flooded as early as 1861 when the Willamette River put four feet of water on them. Since then, severe riverine flooding on the Willamette occurred in 1890, 1924, 1943, 1948, 1956, 1964 and 1996. Major floods on the Clackamas were in 1923, 1931, 1960, 1964 and 1996.

The area affected by the February 1996 flood was roughly the same as FEMA's 100-year floodplain shown in Figure 2-1. Federal disaster assistance figures (FEMA's Individual Assistance programs) show the extent of the problem:

<u>Federal</u> <u>Cost</u>	<u>Oregon City</u> <u>Households</u>	<u>Program</u>
	300	Applied for assistance
\$369,000	125	Were provided with temporary housing support while they repaired and rebuilt. Many others stayed at friends' and relatives' places and did not need temporary housing aid.
\$134,500	36	Lower income or fixed income residents given Individual and Family Grants.
\$833,000	45	Families received low interest reconstruction loans.

In contrast to these disaster assistance figures, there were few flood insurance policies in effect before the flood. There were only 12 flood insurance claim payments, but the following numbers show that the few who were insured received much higher payments than those who received disaster assistance. Two of the residential properties are located outside of the mapped floodplain. They apparently are subject to a local drainage problem.

\$123,000	5	Residential properties
\$397,000	4	Commercial properties
\$449,000	3	Publicly owned properties (including County public works)

The Interagency Hazard Mitigation Team Report on the 1996 flood noted that 65% of the total damage in the state was incurred by state and local governments. The direct cost to the Oregon City treasury from the February 1996 flood is estimated at:

\$ 75,000 in flood fighting expenses
125,000 for debris removal, cleanup, and soil testing (near the landfill)
167,000 for repairs to city property
\$367,000 in direct costs to the City (includes costs from the February landslides)

Much of this will be paid by Federal disaster aid under FEMA's Public Assistance program, but that simply transfers a local public expense to more taxpayers.

In addition to these quantitative measures of the effects of flooding on Oregon City, there were other types of damage to the community and its economy:

- " Businesses, roads and railroads were closed for days and weeks during the high water, which had a regional as well as local economic impact.
- " Several businesses closed permanently after being damaged in 1996.
- " The U.S. Post Office has had a problem with moisture and will be relocating out of the floodplain.
- " Clackamas County's public works center was flooded more than eight feet deep. County crews spent their time rescuing County equipment and were not free to fight the flood and help residents elsewhere.

While 1996 is fresh in many memories, the floods of 1861, 1890 and 1964 went higher. And there have been floods since then. The Willamette and Clackamas Rivers flooded in January 1997 following severe winter storms.

2.2. Landslides

Source of the hazard: Most landslides occur when there is too much water. When the ground is saturated, a landslide may occur where there is loose soil on a steep hillside. [In this plan, the term "landslide" includes rockslides, mudslides, debris flows, earthflows, and slumps.]

Activities that steepen slopes or add weight or water to the slope can cause slides. Grading for road construction and other purposes and erosion are examples of how slopes are steepened. Adding fill material to a slope, or increasing the saturation of a slope by removing vegetation, altering drainage and runoff flow patterns are examples of increasing the weight of the slope. Water also can weaken the material's ability to resist sliding.

Generally, a combination of these factors work together, cumulatively decreasing the stability of a slope until one triggering event initiates the landslide. Triggering events include heavy rains, earthquakes or heavy traffic that shake a saturated area, or when the lower edge of a hillside is removed or washed out.

Area affected: The areas most likely susceptible to landslides are those with steep slopes. Figure 2-2, at the end of this report, shows those areas in Oregon City with more than 25% slopes.

Landslides tend to occur where older landslides have occurred before. In fact, sliding commonly involves reactivated landslides. Although landslides are due primarily to the force of gravity and can occur without warning at any time, they often are seasonal since they often are triggered heavy rainfall. Geologists can identify conditions in landslide prone areas and predict if and when landslides are likely to occur.

The cause and effect relationships are not necessarily confined to an immediate area: Conditions or actions on one parcel of land can cause slides on other parcels. Although the total area of land with a high potential for landslides is small, the consequences are serious when structures, roads, utility system components are in the path.

For example, one site particularly ripe for causing extensive problems is the hillside along the north bank of Abernethy Creek. A slide here could sever the water main serving West Linn and block the Creek – affecting people in other communities who are dependent on the water and businesses that would be flooded.

Threat to life and safety: During the February 1996 disaster, five people were killed by landslides in other counties. Where landslides damage infrastructure, such as streets, water pipes and power lines, the health and safety impact can be far reaching. The threatened water main is an example that could have serious public health repercussions. The South Fork Water Board is investigating alternative ways to protect this key lifeline.

Threat to property: Landslides destroy or damage anything on the sliding hillside or in the path of the slide. This includes buildings, houses and streets. Sometimes, a small amount of settlement occurs, giving the owner time to shore up or retrofit the building to prevent further damage. Oregon City has built several retaining walls and replaced slide prone soils with rock to prevent landslides. However, if the entire hillside goes, the buildings are “totaled” and the streets are washed out or covered in debris.

History: The most comprehensive and recent summary has recently been published for Metro as *Landslides in the Portland, Oregon Area Resulting from the Storm of February 1996*, by the Portland State University Department of Geology. It notes that “Landslides have always been an active process in the Portland area.” However, human activity has aggravated the problem. The report inventoried 701 landslides and found that changes to the slope, through cutting or filling, helped increase the risk of landsliding in 76% of the cases.

The Portland State report reviewed 48 landslides that occurred in Oregon City in February 1996. One-half of the slides were considered “natural.” Human activity was involved in triggering the others, including:

- " 5 – the slope had been cut and steepened
- " 9 – fill had been placed on top of the natural ground
- " 10 – human activity, such as driveway runoff or clogged gutter, diverted water

Only 20 of the 48 landslides were identified as “fixed,” i.e., some reconstruction or mitigation action had been taken. These varied from installing rockfill to construction of a retaining wall to closing the affected road.

The available data on the costs of the February 1996 disaster do not differentiate between damage by the floods and damage by landslides. Because most of the damage was due to flooding, the costs are reported in the previous section on flooding.

2.3. Earthquakes

Source of the hazard: Oregon City is subject to ground shaking from two sources:

- " Nearby sources include known, suspected, and probably unknown faults in the metropolitan area.
- " Subduction zone earthquakes which occur at greater distances and depths.

There has been little research into local faults to determine their historical and potential seismic activity. However, there is a direct relationship between a fault's length and its capabilities for generating earthquakes. Smaller nearby faults produce lower magnitude events, but their ground shaking and damage can be intense because of the fault's proximity and local soil conditions..

Subduction zone events can have great magnitudes, but because of their distance and their depth may result in only moderately intense shaking in Oregon City. Ground shaking causes most of the damage. Fault rupture itself will occur only from local crustal events, and while sometimes spectacular, these cause only a small percentage of damage.

Earthquakes can trigger other types of ground failures which could contribute to the damage. These include landslides, dam failures, and liquefaction induced spreading and slumping. Where these hazards exist in Oregon City, it is prudent to assume that moderate to strong ground shaking will result in ground failures.

Shaking can mix groundwater and soil, liquefying and weakening the ground that supports buildings and severing utility lines. This is a special problem in low lying areas adjacent to rivers where the water table is shallow and the soils are subject to liquefaction. For example, the alluvial soils near the confluence of the Willamette and Clackamas Rivers and Abernethy Creek are likely subject to this hazard.

Area affected: The entire City is vulnerable to the earthquake hazard. Figure 2-3, at the end of this report, shows four zones of relative hazard. However, a geotechnical study is necessary to determine the existence and the extent of the hazard at any specific location.

It should be noted that the most hazardous area, the red Zone A, coincides with the most severe floodprone area north of Abernethy Creek (see Figure 2-1). This is primarily due to the alluvial soil and high water table found in floodplains that are most subject to liquefaction during an earthquake.

Within each zone, different buildings utilities and transportation systems are affected differently. Unreinforced masonry buildings, such as those in the downtown area, perform very poorly even in moderate earthquakes. Other types of construction, such as older concrete frame and newer (“tilt-up”) concrete wall buildings also perform poorly.

Single family dwellings, if not properly bolted to their foundations or having inadequate foundation systems to resist earthquakes (e.g., post and pier, cripple wall, stone, etc.) can also suffer major damage.

Threat to life and safety: Vulnerable buildings, roads, bridges and utility lines and the unpredictability and instantaneous nature of earthquakes can result in enormous losses of life. Because the greatest potential for loss of life is to people within a collapsing building, the true extent of the risk is dependent on a review of each building.

For example, one of the few reviews that has been completed was done for Oregon City’s main fire station. This is an older (1930’s) concrete frame structure. A 1997 evaluation noted “that in the building’s present condition, it does not have the strength to resist the horizontal forces that could result from a large earthquake” [*Strategic Plan for the Oregon City Fire Department, Exhibit 7*].

A preliminary review of selected potential impacts of two earthquakes on Clackamas County was completed using “HAZUS,” a new loss estimation program. Because Oregon City dominates the county’s urban pattern, for planning purposes these losses can be assumed to be concentrated in the City limits. [Metro will be conducting a more detailed HAZUS analysis in the near future.]

The first event was a repeat of an 1877 event on an unknown fault, the epicenter of which was about 12 miles northwest of Oregon City. It was estimated to have had a 6.3 magnitude on the Richter Scale. The review found an estimated 15 relatively minor injuries (no fatalities) if the quake occurred at 2:00 a.m. or 2:00 p.m., and only 9 injuries killed at 5:00 p.m. (because fewer people would be in buildings)

A similar review was made assuming a hypothetical magnitude 7.0 earthquake along the Portland Hills Fault. This fault runs through the western portion of Oregon City and trends northwest, slightly west of the Multnomah County line. Random epicenters were used for statistical purposes. The number of predicted injuries increased from 15 to 110 and 9 to 69, respectively.

The threat can be reduced by properly locating structures and designing and constructing them to the latest codes and standards containing seismic design requirements. When proper codes and other measures are followed, seismic safety improves over time as older, more vulnerable buildings, utilities and transportation systems are replaced. However, the existing inventory of buildings built to earlier standards (or no standard) can pose major threats to life safety or the functioning of key community services.

Threat to property: A few buildings, bridges, and other structures are likely to collapse or dislodge heavy elements (e.g., parapets), causing casualties. Other types of property damage will be more widespread. Examples of other types of property damage include:

- " Failures of older dwellings, especially if not bolted to their foundations;
- " Fallen ceiling tiles and light fixtures;
- " Broken water pipes and other utility services in buildings;
- " Loss of inventories;
- " Business interruption,
- " Potential loss by fires due to broken gas,
- " Interruption of service due to broken water and sewer lines, and
- " Loss of utility services due to damage to wastewater treatment facilities, bridges and overpasses, natural gas pipes, and electrical power facilities and lines.

The preliminary HAZUS run of the 1877 event found about 27% of seven common types of buildings would experience moderate to complete damage while about 58% would have no or only slight damage (assuming low earthquake design levels). Concrete and masonry buildings were the most affected. The review of the hypothetical magnitude 7.0 earthquake along the Portland Hills Fault found that the moderate to complete building damage figure went from 27% to 61%.

History: Historical records count over 56 earthquakes in the Portland area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent was in the March 25, 1993 Scotts Mills quake. It was a moderate shallow crustal earthquake (5.6 magnitude with aftershocks continuing at least through April 8). It occurred in a previously recognized fault zone. In the three county area that received a Presidential disaster declaration, it was reported that

More than 30 public buildings sustained damage which was concentrated in old masonry buildings. Several buildings require rebuilding. At least 4 fire stations, 1 telephone facility handling the area's 911 capabilities, 16 schools, 5 city halls, 1 medical center, 1 police station, 1 correctional facility, and 1 library were damaged...
[*Hazard Mitigation Survey Team Report, FEMA-985-OR, page 4*]

To put this event into context, the above report noted that "*this earthquake is the tip of the iceberg concerning Oregon's earthquake potential.*" [page 3, emphasis included], and "Recent research shows evidence that major structures capable of magnitude 7 plus earthquakes run through some of our metropolitan areas including Portland..." [page 33] Thus, it is safe to assume that more earthquakes, possibly of greater magnitude, have and will occur again in the region and affect Oregon City.

2.4. Volcanic activity

Source of the hazard: Volcanic eruptions can be devastating and long lasting. In addition to their flows of lava and debris, emissions of toxic gasses, and extensive deposits of airborne particles and ash, eruptions can also be accompanied by earthquakes, landslides, floods (due to snowmelt or dam breach), and other hazards, including altering weather worldwide.

Debris flows and lahars (flows with water, ice or snow) can wipe out everything in their path. Sometimes debris flows can dam streams and rivers, resulting in impoundment of water and debris behind very unsafe structures. The resulting potential failures can add to damage along the streams.

The Cascades, shaped largely by volcanic activity, account for much of the area's topography. Most of the chain of volcanoes running from the State of Washington through Oregon to northern California are active or dormant. Few are judged by scientists to be extinct.

The 1980 eruption of Mt. St. Helens served as a strong reminder of the hazard to Metro area residents. Because of the wind patterns, the Metro area received a relatively minor ash fall when Mt. St. Helens erupted.

There is another active volcano even closer -- Mt. Hood. Again, whether Oregon City would be affected by ash fall would depend on wind patterns. According to a recent U.S. Geological Survey report (USGS Report 97-89), Mount Hood has a 1-in-15 probability of erupting during the next 30 years.

However, the report shows most of the hazardous results, such as hot volcanic flows and river flooding, would affect areas to the north and east of Oregon City (closing roads and railroads that serve the City). It is possible that some of the upper Clackamas River watershed would be affected, such as the Timothy Lake dam.

Area affected: Severe disruption of Oregon City is not expected from most of the effects of an eruption of Mt. Hood or Mt. St. Helens. The most likely problem would be ashfall, but the prevailing westerly winds most likely will carry most of the ash eastward. However, there is concern about nearby watersheds and associated facilities that store, transmit, and treat water for communities in the area. Prolonged water outages could have severe social and economic impacts.

Threat to life and safety: Except for possible minor disruption from potential ashfall coming west from Mt. Hood (or south from Mt. St. Helens) under unusual wind conditions, few threats to people in Oregon City are expected. People can be protected if they take precautionary respiratory measures, such as shutting ventilation systems and closing and or sealing all openings to buildings.

However, it is possible that the threat could become serious enough to warrant evacuation, especially if slides or seismic activity produce flood hazards or break dams. Such activity could result in lost power or lost water supplies, which would have a public health impact beyond the area directly affected by the eruption.

Threat to property: Little, if any, property damage is expected from an eruption of Mt. Hood or Mt. St. Helens. If sufficiently severe ash fall occurs, vehicles, air conditioning, and other air inducing systems may be damaged, and roofs (especially flat ones) should be monitored and cleared so as to avoid excessive weight and potential collapse.

History: Mt. St. Helens' famous 1980 eruption is well known in the area. While not as active recently, Mt. Hood has experienced four major eruptions during the last 15,000 years. The most recent occurred 200-300 years ago. Emissions also occurred in 1859, twice in 1865, and in 1903 when steam and fragments of rock and lava were ejected. During the past 2,000 years lava domes at Mt. Hood have grown and collapsed creating hundreds of pyroclastic flows extending 11 kilometers down the mountain's southwest flank. This volcano remains in an active state.

2.5. Wind and ice storms

Source of the hazard: Wind and ice storms are caused by severe weather conditions. Wind storms can occur at any time of the year while ice storms are limited to the winter months. Wind storms are usually "straight line" storms with winds that do not exceed 90 miles per hour, although wind speeds as high as 119 mph were recorded in Portland in 1962.

An ice storm can be accompanied by high winds. Wind and ice storms are addressed together because they also have similar impacts, particularly in the form of damage to trees and power lines.

Area affected: These storms affect the entire city.

Threat to life and safety: There is a relatively low threat to life and safety because people usually have time to seek shelter. The types and condition of building construction offer protection from most storms likely to threaten Oregon City. The loss of antennas and telephone lines hampers emergency services and radio and television broadcasts.

If streets are icy or power lines are down on roads, there is an added hazard to drivers. If steep streets are icy, it is difficult for emergency equipment to travel and there can be a secondary threat to life if police, fire or ambulance vehicles cannot respond to calls. Such calls often increase due to accidents to pedestrians and fires during storms and power outages.

Threat to property: The major damage to property is to exposed utilities, especially power lines and water pipes. Ice, wind and broken tree limbs wreak havoc on these wires. Buildings and vehicles are affected when tree limbs fall on them.

Water pipes break in older buildings with water lines that do not meet the current building code (which requires the pipes to be in interior or insulated walls). Another problem is lost business when businesses are closed due to inclement weather or loss of power.

History: Wind and ice storms have occurred many times. In areas west and south of Oregon City, a December 1995 storm had wind speeds over 110 miles per hour - hurricane force speeds. Up to 400,000 people were without power.

The most recent ice storm was in January 1998. A severe winter storm dropped freezing rain and snow and was accompanied by high winds for two days. Most of the city lost power due to downed electrical lines and malfunctioning transformers. One emergency shelter was opened for those who could not stay in their homes.

Off-duty firefighters were called in to help respond to the increased number of calls. It is estimated that property damage from fallen tree limbs was between \$500,000 and \$750,000, plus the cost of repairing or replacing the trees.

2.6. Wildland/urban interface fires

Source of the hazard: Wildland/urban interface fires occur where development extends into forested areas or where vegetation surrounds a building. What would be merely a forest fire, becomes a threat to buildings when they are placed in the middle of a forest and inadequate fire resistant construction, steep terrain, poor access, and limited water supplies complicate fire fighting efforts.

Area affected: There is no map of high wildfire potential areas available at this time. Areas subject to the hazard have the following characteristics:

- " Steep slopes with limited year-around water availability;
- " Extensive use of highly flammable material on structure exteriors (e.g., wooden shake or shingle roofs);
- " Narrow and steep roadways to developed properties making access difficult;
- " Inadequate or poorly placed fire hydrants; and
- " Combustible landscaping, brush or debris located close to structures.

Such areas may be outside of the City's boundaries and not subject to its regulations, but fires could migrate into the City.

Threat to life and safety: The compounding effects of a fast moving fire, especially if wind driven, limited avenues for evacuation and mobility for fire suppression forces, poor visibility, extreme heat, limited mobility of some residents, and other factors combine to make wildland/urban interface fires extremely dangerous.

Threat to property: Buildings caught in a wildland/urban interface fire area nearly always destroyed. Usually, full reconstruction or replacement of the structures is necessary. Some structures can be saved, and others survive because of adherence to fire-safe measures and defensive actions taken by property owners and responding fire protection agencies. It is

important to note that the nature of the development that has increased this risk is a relatively recent phenomenon.

History: There was a major fire along nearby Rosemont Ridge following a long dry spell in September 1967. It burned 300 acres and cut telephone and electrical service, but fire fighters saved all the threatened homes. However, less than two weeks later another fire destroyed 500 acres. This one took the efforts of over 150 firemen to save the homes.

2.7. Hazardous materials

Source of the hazard: Hazardous materials are materials that are explosive, flammable, combustible, corrosive, oxidizing, toxic, infectious or radioactive. There are more than 2,400 substances identified as “hazardous” by the U.S. Department of Transportation.

These materials are not a problem when properly contained and stored. However, if they are spilled, burned or otherwise released in quantity, they can be a severe threat to people and natural resources. It should be noted that a release can be caused by one of the other hazards covered in this plan, such as an earthquake or flood.

Because of this potential hazard, Congress passed the Superfund Amendments and Reauthorization Act (SARA). Title III of that act requires companies that use hazardous materials to report them to local authorities.

Area affected: There are three primary sources of hazardous materials problems: production and use during manufacturing, release during storage and damage during transportation. There are no facilities that produce, or have manufacturing processes that use, hazardous materials in quantity.

There are six sites that store “extremely hazardous” materials as reported under SARA Title III. These are shown in Figure 2-4, at the end of this report. This map which also shows the natural gas pipeline which runs through the southeast corner of the City. It should be noted that three of the six sites are in the area subject to the greatest threat from flooding and ground failure due to earthquake.

The major transportation routes for materials that could be hazardous are also shown in Figure 2-4. The primary threats are the railroad lines, Interstate 205, highways 99E and 213, and the pipeline. All trucks on Interstate 5 between Seattle and California are required to go around Portland on Interstate 205.

Figure 2-4 actually only shows the more likely *sources* of a hazardous materials incident. Larger areas could be *affected* by fire, traffic rerouting, and deadly airborne gases that could be caused by damage to a hazardous materials storage site or vehicle.

Threat to life and safety: Hazardous materials problems are a major threat to life and safety. The materials can kill or maim unprotected people. The most infamous case was the release of toxic chemicals in Bhopal, India which killed 4,000 people in 1984.

Threat to property: As noted above, hazardous materials problems are primarily a threat to life and safety. Property damage can occur due to explosions or fires which are harder to fight than other types of fires.

History: Historical incidents of hazardous materials problems are connected to other disasters. The 1996 flood affected three of the six sites shown in Figure 2-4. Impacts included:

- " The Tri City wastewater treatment plant was flooded. Although it was very diluted, wastewater was allowed to bypass the plant and flow into the Clackamas and Willamette Rivers.
- " The Metro solid waste transfer station has a household hazardous waste collection facility which was flooded. Fortunately, the floodwaters did not damage the facility,
- " The closed sanitary landfill. While this did not appear to be damaged, the City spent \$44,000 to test the soils around this facility and the solid waste transfer station.

2.8. Future development

The information on the hazards and their impacts discussed above is based on the City's current condition. Future development can result in worsening of the problems. The entire Portland Metro area is subject to tremendous growth pressures due to its desirable location and the restrictions on urban sprawl placed by the urban growth boundary requirements.

Figure 2-5, at the end of this report, shows the areas within the urban growth boundary designated as vacant according to the City's buildable land survey. Given the area's growth rate and development regulations, it can be expected that these sites will be developed over the next 10 - 20 years.

Figure 2-5 also shows areas designated as unsuitable for normal development due to steep slopes, floodplain location, public ownership, or other constraint. If these areas are allowed to develop without proper land use or construction controls, the City will be faced with a greater exposure to damage from landslides and wildfires.

One area in particular is subject to several hazards. The lower lands north of Abernethy Creek and west of Route 213 are outlined in Figure 5-1. This area is subject to the City's greatest concentration of hazards, including:

- Flooding from all three sources of riverine flooding,
- Deep flash flooding if the dams on the Clackamas River fail,
- Landslides along the south bank of Abernethy Creek,
- Severe earthquake hazard where the soils are subject to liquefaction.
- Several hazardous materials storage sites, and

- Hazardous materials spills from vehicles on the highways or railroad.

This area is the most hazardous place in Oregon City for future development to occur. However, this area is also a prime location for development to occur because:

- It is close to transportation facilities,
- It is close to the scenic riverfront,
- It has vacant land, and
- It is zoned for industrial and commercial uses.

If the potential for damage from the hazards described in this plan is ignored, development in this multi-hazardous area would greatly increase the threats to life, safety and property.

Future development can also aggravate problems in other areas. By replacing vacant land with rooftops, pavements and storm sewers, runoff of stormwater from these areas will increase. Unconstrained watershed development often will aggravate downstream flooding and overload the community's drainage system. Similarly, development uphill can increase the likelihood of a landslide downhill.

In short, while the City has substantial exposure to danger to people and damage to existing property, the threat can easily grow worse without proper management of both where future development goes and how it is built.

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Chapter 3. Goals and Objectives

As explained in Chapter 2, the lives and property of the residents of Oregon City are threatened by a variety of natural and man-made hazards. This chapter sets goals and objectives for subsequent City activities to mitigate the threats from those hazards.

Goal 1. The foremost goal is the protection of life.

Objective 1.1. The emergency management system should provide early warning of all life-threatening hazards that can be predicted, i.e., flood, dam failure, landslide, severe weather (e.g., ice and wind storms), wildfire, and hazardous materials incidents.

Objective 1.2. Residents and businesses should be given information on safety and health precautions to take during a disaster.

Objective 1.3. Emergency response plans should give top priority to measures that protect people. Examples include evacuation routing, sealing off roads threatened by landslides, and search and rescue in damaged buildings.

Objective 1.4. Special attention should be paid to responding to hazardous materials incidents as they can happen at any time without warning and can be secondary effects during other types of emergencies.

Goal 2. Future development should be protected from natural hazards.

Objective 2.1. Land use plans and regulations (including Urban Growth Boundary and Urban Reserve Area delineations) should designate the larger vacant and natural areas subject to the site-specific natural hazards of flooding and landslides as not available for intensive development.

Objective 2.2. Where areas are not set aside from development, appropriate investigations and protection measures should be required before development plans are approved.

Objective 2.3. New buildings and substantial improvements to existing buildings should incorporate all appropriate construction measures to protect them against failure or damage during an event.

Objective 2.4. Proposals for new subdivisions and other major developments should be reviewed to ensure that they do not cause problems to other properties due to stormwater runoff, inappropriate vegetation, inadequately stored hazardous materials, etc.

Goal 3. Existing properties exposed to natural hazards should be protected from damage by those hazards.

Objective 3.1. Area mitigation plans should be prepared where there is a concentration of properties subject to a high risk from one or more hazards. Such plans should consider the full range of alternatives, including acquisition and relocation.

Objective 3.2. Site-specific measures should be taken at known high hazard sites, such as landslide-prone hillsides above important roads and hazardous materials storage facilities.

Objective 3.3. Ongoing maintenance programs, such as channel inspection and clearing, should be continued to reduce the potential for creation of a problem.

Objective 3.4. Residents and businesses should be advised and assisted in taking appropriate mitigation steps to protect their own property.

Objective 3.5. A hazard analysis and risk assessment should be conducted on each critical facility and each publicly-owned facility followed by a determination of appropriate and cost effective mitigation measures.

Chapter 4. Mitigation Measures

There are five general strategies to approach mitigating the impacts of natural hazards. This chapter reviews each and the variety of measures that can be used to pursue each strategy.

Many of the sections reference the “IHMT Report.” This is the *Interagency Hazard Mitigation Team Report* prepared by a team from state and federal agencies following the February 1996 flooding and landslides. It includes many mitigation recommendations for state and federal agencies to pursue. However, in most cases there has been no follow up to determine if they have been accepted or implemented.

Some of the measures are mandated, i.e., state or federal law require that they be implemented by the City. Several of these come from “Metro Title 3,” a model ordinance recently adopted by Metro that covers development activities that affect water quality, flooding and water resources.

Another program referenced several times is the National Flood Insurance Program or NFIP, which is administered by FEMA. The City must meet the regulatory requirements of the NFIP for flood insurance to be available for properties in the City limits. The NFIP has a voluntary program called the Community Rating System. This is referenced also, because it has many model programs and recommendations on how communities can improve their flood-related activities.

4.1. Structural projects

Structural projects are used to prevent the hazard from reaching developed areas. These measures are "structural" because they involve construction of man-made structures to control water or debris. This section reviews structural projects that can control riverine flooding, local drainage problems, landslides and wildfires. There are no known structural projects to control earthquakes, volcanos, or wind and ice storms. [Hazardous materials spills can be contained by levees, similar to the ones discussed in the next section.]

Most structural projects can be very expensive. They have other shortcomings, too:

- " They disturb the land and disrupt natural water flows, often destroying habitats.
- " They require regular maintenance, which if neglected, can have disastrous consequences.
- " They are built to a certain protection level that can be exceeded by larger flows, causing extensive damage.
- " They can create a false sense of security, as people protected by a project often believe that a flood or landslide can never reach them.

4.1.1. Flood control projects

There are four main types of flood control projects: reservoirs that retain excess water upstream, levees that keep the water off of certain areas, diversions that divert high flows to other areas, and modifications to increase channel capacity.

Reservoirs: Reservoirs control flooding by holding high water flows or debris flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can handle downstream. Reservoirs and wet or dry storage basins can serve multiple uses by doubling as parks or other open space uses.

Levees: Probably the best known structural flood control measure is a barrier of earth (*levee*) or steel or concrete (*floodwall*) erected between the watercourse and the property to be protected. One problem with this measure is that it may push the hazard onto other properties. Levees around storage tanks can provide protection from another hazard: hazardous materials spills.

Diversions: A diversion is simply a new channel that sends floodwater to a different location, thereby reducing damage to property that would otherwise be in harm's way or keeping landslide prone areas drier. Care must be taken to ensure that the diversion does not cause a new problem. Even the appearance of transferring the hazard to someone else greatly complicates — and often halts — a diversion project.

Channel modifications: By increasing the conveyance of a stream channel or drainage ditch, more water is carried away. However, care must be taken to not increase a flooding problem downstream. *Channel modifications* include making a channel wider, deeper, smoother or straighter. Some smaller channels can be lined with concrete or even put in underground pipes.

Dredging is one form of channel modification. Dredging is often cost prohibitive because the dredged material must be disposed of somewhere and the stream will usually fill back in with sediment in a few years. Dredging is usually undertaken on larger rivers only to maintain a navigation channel.

Current implementation: There are some dams upstream from Oregon City on the Willamette, Clackamas and Abernethy. The Corps of Engineers operates 11 reservoirs on the Willamette and its tributaries that reduce flood stages at Oregon City.

Other dams were constructed for power generation or to enlarge a recreational reservoir and are not for flood control. They are of limited value to control flood waters as their owners are not likely to support drawing down the reservoirs before the rainy season to provide flood storage capacity.

Possible changes: No federal or state agencies have plans for new structural flood control projects on the three rivers affecting Oregon City. The IHMT Report calls for acquiring and improving “natural floodwater containment basins” (page 69).

A levee has been discussed by City officials. It would run along the south side of Abernethy Creek to protect the first level downtown from local flooding. This idea has not yet reached the engineering planning stage and could face regulatory constraints that may make a levee infeasible.

Recommendation 1.1.A: A structural project to protect portions of the city from flooding by the Clackamas or Willamette Rivers would be a tremendous undertaking. Reservoirs or levees large enough to impact flooding of these rivers would require a lot of land and a lot of money. Reservoirs would benefit other communities as well.

Such projects should be undertaken on a regional basis with assistance from the major flood control agencies, the U.S. Army Corps of Engineers and the Natural Resources Conservation Service. It is recommended that these agencies, along with Metro and the State, investigate flood control alternatives on these two rivers. Special attention should be paid to the use of naturally floodprone open space or wetlands as flood storage areas.

Recommendation 1.1.B: The City should review flood control alternatives for Abernethy Creek. Assistance may be provided by the Corps of Engineers and the Natural Resources Conservation Service.

4.1.2. Landslide control measures

There are four main ways to control landslides at known hazardous sites: control the drainage, construct a retaining structure, regrade the slope, and catch or divert the slide.

Drainage control: The amount of water in the soil can be controlled by ditches and other conduits that divert surface flows around the more slide-prone slopes. Subsurface drains can also reduce the water levels in the slope. Slopes threatened by undercutting or soil saturation from streams at their toes can be protected by flood control measures that reduce the streams' flows and erosive forces.

Retaining structure: A wall or structure constructed at the bottom of the slope can hold the hillside in place and/or protect it from undercutting and erosion. Where the slope failure includes the threat of rockfall, wire fencing can be overlaid on the slope to retain the rocks.

Excavation or regrading: The hazardous slope can be regraded to a more shallow incline, reducing the possibility of slumping or sliding. It can also be dug out and, if necessary, replaced with less slide-prone materials, such as large rocks.

Catching or diverting the slide: A debris basin at the bottom of a known landslide area can catch the material. After the slide, the basin must be excavated so it will work during the next slide. In some cases, a barrier can be erected to deflect the slide away from a developed area. These approaches don't prevent the hazard, but they can keep it from damaging certain properties.

Current implementation: The first three measures have been implemented in Oregon City. Where appropriate, the City Department of Public Works has constructed projects to control or reduce the hazard.

Drainage controls, in the form of extending storm sewer outfalls to the bottom of steeper slopes, have been installed on several hillsides. An example of a retaining wall and excavation and replacement with rock can be seen above Singer Hill Road, between 7th and 10th Streets. This extensive project is needed to keep this important access road open.

Where there are no structures at risk, some slopes have not been addressed. For example, instead of installing an expensive project to protect from a slide on the hillside south of Abernethy Creek, McLoughlin Avenue has been closed. The area downhill from this slide is vacant and uphill is a City park. Rather than control this slide, it may be more cost effective to let nature take its course, leave the area vacant and abandon the street.

Possible changes: There are no known changes being considered to the current City policy of installing cost-effective projects where warranted.

Recommendation 1.2: The City should continue its current policy of installing landslide control projects where warranted. Such projects should be carefully engineered so:

- " The most appropriate measures are used,
- " The costs are justified by the benefits, and
- " There are no adverse impacts on other properties.

4.1.3. Drainage system improvements

Surface water is directed to the larger receiving rivers by the drainage system. The drainage system consists of natural channels and man-made channels and underground pipes. Usually, a flood larger than a 2-year flow goes overbank in a natural channel. Man-made drainage channels are usually built to a higher standard, such as the 10-year storm.

Urban development can quickly overload the drainage system, due to the increased runoff from new rooftops and streets. Often, “choke points” develop where heavy flows reach constrictions and back up and flood nearby areas. This usually happens when an open ditch goes into a culvert or storm sewer or where ground changes shrink the channel width.

The solution to choke points and undersized drains are improvements that open up the constriction, enlarge the conduit, or store excess water upstream and allow it to flow out in smaller amounts over a longer period of time. Other drainage system improvements prevent or reduce erosion to channel banks or remove sediment from the channel bottoms. One problem with these improvements is that, if not planned out carefully, they may pass a flooding problem downstream to unsuspecting properties.

Current implementation: In 1988, the City adopted a *Drainage Master Plan*. This set up a framework for detailed planing for each of the 22 identified drainage areas. Studies are conducted on each area to produce a recommended list of improvement projects. To date, two basin plans have been completed, a third is nearly done and two more have been started. These studies review existing problems and requirements for new development.

A unique drainage structure exists in the Willamette River floodplain at South 2nd Street. A 30" storm sewer pipe extends over the railroad tracks and drains into a large “downspout.” This structure was cracked during the February 1996 flood. It should be examined and/or repaired in order to ensure the proper flow of drainage from the nearby “second level” properties.

Possible changes: There are no changes planned in the current approach.

Recommendation 1.3: The City should continue the detailed studies of the rest of the basins. The recommendations should be consistent with the direction and standards in the new design manual for stormwater facilities (discussed in Section 4.4.3). Special attention should be given to facilities damaged by recent events.

4.1.4. Drainage system maintenance

Channels, storm sewers and detention basins guide surface waters and catch overflows. If these facilities are not maintained, they can’t do their job and flooding (both riverine and, more likely, local drainage) results. Maintenance is an ongoing program to clean out blockages caused by overgrowth or debris.

Current implementation: Two utility workers in the Department of Public Works perform drainage system maintenance. This work includes cleaning catch basins, inspecting known problem areas, sweeping the streets, and clearing sewer inlet grates after storms.

It is estimated that 3/4 of the debris removed from open channels is from natural growth, including grass and tree cuttings. The remaining 1/4 consists of man-made objects, such as shopping carts. The major maintenance need is in open channels, culverts and bridges. Sanitary sewer backups are an isolated problem.

Much of the City’s drainage system is hard to reach, being at the bottom of steep ravines with no ready access roads. Current resources only allow regular inspections of known trouble sites, spot inspections of the rest of the system and thorough cleaning of only one mile of channel per year. The most recent cleaning project was on High School Creek. Over 80 tires were removed, but some of the creek still wasn’t reached.

The City has no formal written maintenance procedures. It does have a State stormwater discharge permit which authorizes certain types of work. However, the thrust of the permit relates to maintaining water quality. Some projects, such as clearing downed logs from Abernethy Creek, are prohibited from September through June due to water quality and salmon habitat protection rules.

As noted in Section 1.1, many local drainage problems are directly caused by nearby property owners who fill or dump in their ditches and swales. There is no formal program to inform the public about these problems or to fine them for dumping.

Possible changes: The City has recognized the need for a more active maintenance and prevention program. New rules on working in streams affected by the Endangered Species Act encourage the development of new procedures. However, current funding levels restrict expanding the level of maintenance. A proposal to increase the stormwater utility fee was submitted to the Rate and Fee Review Committee in 1997, but it has not been acted on.

The IHMT Report called for a statewide debris management policy that reconciles channel work and habitat preservation (page 65). It also recommends development of stream bank stabilization techniques that also reconcile these two competing objectives (page 68). A group now meets every other month to discuss these issues.

Recommendation 1.4.A: A formal channel maintenance program should be prepared. The first step would be to map all open drainage channels and known trouble spots, such as undersized culverts (the 1988 drainage plan lists some of these). Much of the information to prepare the program is in the heads of the current maintenance crew members.

There should be a formal evaluation of the drainage system to determine what type of regular maintenance is needed. A written set of procedures should be developed for the utility crew. The procedures should meet the credit criteria of the Community Rating System, should the City want its maintenance program to qualify for a reduction in flood insurance premiums. It should also comply with the rules of the Endangered Species Act.

Recommendation 1.4.B: The cost of implementing the procedures should be calculated in terms of staff time and equipment. This cost should be compared with the funds available from the utility fees. If they are inadequate, the City Commission should decide if improved channel maintenance is worth an increase in fees.

Recommendation 1.4.C: The City should develop a program to inform property owners and others about:

- " The causes of local drainage problems, flooding and landslides,
- " Why channels, ditches and swales should be maintained,
- " What owners can do to protect their properties, and
- " The penalties for dumping in or altering watercourses.

4.1.5. Fuel breaks

Fuel breaks or firebreaks are stretches of open land where fire resistive vegetation grows instead of trees. Roads, parks golf courses, etc. provide barriers between fire-prone growth and development. They can be as small as a clearing around a house or larger stretches to protect subdivisions. They must be maintained so they do not become overgrown with more "fuel."

Current implementation: There are many roads in the area, but no open spaces designed specifically as fuel breaks.

Possible changes: There are no changes planned at this time.

Recommendation 1.5: The City should require new developments to designate fuel breaks in site plans. Development plans should describe the procedures for ongoing maintenance. Where possible, this work should be coordinated with the design of new streets to reduce land costs and facilitate the movement of fire fighting equipment.

4.2. Property protection

Property protection measures are used to modify buildings to protect them from the hazards. From the City's perspective, these can be inexpensive measures because often they are implemented by or cost-shared with property owners. Many of the measures do not affect the buildings' appearance or use, making them particularly appropriate for historical sites and landmarks.

4.2.1. Acquisition and relocation

Where a natural hazard is localized, such as with flooding and landslides, getting damageable property out of the way is the surest and safest way to protect it. While almost any building can be moved, the cost goes up for heavier structures, such as those made of brick, and for large or irregularly shaped buildings. Experienced house movers know how to handle any job.

The major difference between acquisition and relocation is that the former is undertaken by a government agency or nonprofit organization, so the cost is not borne by the property owner, and the land is converted to public use, such as a park. Acquiring and clearing buildings from a hazardous area is not only the best protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Acquisition or relocation is most appropriate in areas subject to flash flooding, deep flood waters or landslides.

Current implementation: There have been no government financed acquisition or relocation projects in Oregon City. Some buildings that were damaged in 1996 are still vacant.

Possible changes: The U.S. Post Office is planning to move to higher ground, but the disposition of its old facility is not known. Some businesses have moved or have plans to move.

Recommendation 2.1: City staff should inventory the buildings worst or repetitively hit by the recent floods, including publicly owned ones. The owners should be contacted to determine their interest in selling and/or relocating.

Staff should then check with potential funding sources, including FEMA's Hazard Mitigation and Flood Mitigation Assistance Grant Programs, to determine the possibility of receiving funds. The City would still need to identify a source to fund the 25% local match and agree to accept title to the property.

An objective priority ranking system should be developed to fairly determine which properties should be funded first. Factors that should be considered in the ranking system include history of damage, presence of hazardous materials, exposure to multiple hazards, and readiness to proceed (e.g., a vacant property would probably score higher than one that is still occupied).

If there are no funding sources immediately available, the City should maintain contact with the owners of these properties and contact them after the next flood or other disaster. It is likely that new sources of funding would be available then and the priority ranking system would be modified to reflect new data.

4.2.2. Retrofitting/rehabilitation

Where the hazard is not severe, buildings do not have to be acquired or relocated. It is less expensive to modify or "retrofit" them. Examples of hazard specific measures include:

- " Flooding: elevating smaller buildings above flood levels and "floodproofing" them by making the walls watertight, sealing openings, or altering the interior so water does not cause any damage.
- " Landslides: engineering improvements to the foundation, such as deeper pilings sunk around a building to keep it in place.
- " Earthquakes: bracing balconies, chimneys, and other overhangs and tying down water heaters, tall cabinets and other items that would suffer damage if they fell over.
- " Volcanic activity: strengthening roofing systems to bear the extra load of ash.
- " Wind and ice storms: moving or insulating water pipes to prevent freezing and bursting, tying down mobile homes.
- " Wildfire: sprinklers, noncombustible or fire resistive wall and roofing materials and spark screens on chimneys.
- " Hazardous materials: tying down and/or anchoring storage tanks so they will be less likely to spill during an earthquake or accident.

Retrofitting is not limited to buildings. Bridges, pipelines, and other facilities can be modified to strengthen them, elevate them, or otherwise protect them from the effects of the various hazards.

Current implementation: When the Clackamette Park restroom building was rebuilt, it was designed to be "wet floodproofed." The building is of bare concrete block and pressure treated wood. There are openings to allow floodwaters to enter and equalize hydrostatic pressure. Because of the materials used, the exterior and interior should suffer no flood damage.

The City of Portland provides information to property owners in combined sewer areas to disconnect downspouts and install backup valves to stop sewer backup flooding. It also provides financial assistance for the latter. [It should be noted that such work must prevent the runoff from aggravating a landslide hazard.]

An apartment building in a slide prone area added retaining walls and deep, augured posts to help prevent it from moving should the ground slide. Some additional retrofitting projects may have been done voluntarily. City staff are not aware of any other projects that may have been implemented.

Possible changes: The County has considered adding another story and abandoning the first floor of the buildings in its flooded public works complex. The lower areas would be wet floodproofed. However, the project would violate the zoning ordinance's limitation on building height and relocation is a more appropriate solution, given the flood depths and critical nature of the property.

There are no other known plans to retrofit buildings.

Recommendation 2.2A: The City should make information on retrofitting available to all property owners (see later recommendations on public information). If there is interest on the part of property owners, the City should explore sources of financial assistance. These could include the Community Development Block Grant and FEMA's Public Assistance (for publicly-owned properties), Hazard Mitigation and Flood Mitigation Assistance Grant Programs.

Recommendation 2.2B: An inventory should be conducted of the major roads, bridges and railroads that serve Oregon City. The inventory should identify their vulnerability to damage by flooding, erosion, landslides and earthquakes. A priority list should be prepared ranking the most important sites subject to the greatest possibility of damage. The City should then work with the appropriate agencies (e.g., ODOT) to retrofit those facilities.

4.2.3. Drainage/site improvements

Rather than modify a building or facility, it may be safer or cheaper to modify the ground or surroundings to protect a property. A berm in the backyard can keep shallow floodwaters from reaching a building. Clearing brush at least 30 feet from buildings is one of the best wildfire protection measures. Surface and subsurface drainage facilities can keep water from saturating soils in landslide prone areas.

Current implementation: There have been several projects built next to buildings in landslide-prone steep slopes. These have included retaining walls downhill from the buildings and small drainage diversion structures on the uphill side. One example of the latter was a new curb that was built by the City to deflect runoff. The others have been paid for by the owners.

Possible changes: There are no plans for changes to the current approach of reviewing each situation as needed.

Recommendation 2.3: The City should make information on local site improvements available to all property owners (see later recommendations on public information). If there is interest on the part of property owners, the City should explore sources of financial assistance. These could include the Community Development Block Grant and FEMA's Public Assistance (for publicly-owned properties), Hazard Mitigation and Flood Mitigation Assistance Grant Programs.

4.2.4. Property maintenance/retrofitting codes

This approach mandates retrofitting for buildings or other facilities. Such codes can be enforced over a period of time, at resale, or when a property owner applies for a permit to alter or improve the structure.

Mandated measures: The National Flood Insurance Program requires that substantially damaged or substantially improved buildings must be elevated above the flood level (nonresidential buildings can be elevated or floodproofed). A building is substantially damaged if the cost of repairs exceeds 50% of the building's pre-damage value (no matter what caused the damage). A substantial improvement is a project that exceeds 50% of the building's current value.

This requirement can be especially difficult to enforce after a flood or other disaster that affects many buildings in the floodplain. In many cases, it is only felt to be successful when financial assistance is provided to the disaster victims to help them repair the damage and bring their buildings up to code.

The IHMT Report states "there is inadequate understanding of the need and processes for local governments to follow in assessing substantial damage cases" (page 26). The Report also recommended a revision to the state law and provision of a pool of trained building inspectors to help community staffs after a disaster (pages 34 and 35).

Current implementation: The City has adopted the Uniform Housing Code which sets minimum building maintenance requirements.

Most, if not all, buildings that were flooded suffered "soaking" damage - sheetrock and insulation had to be replaced, but there was no damage to structural parts of the buildings, such as floor joists and studs. Therefore, no building permits were required. This may be legal under the building code but violates the intent of the National Flood Insurance Program.

According to the NFIP flood insurance records, there were 12 buildings that received flood insurance claims after the February 1996 flood. Four of them received claim payments greater than 50% of the adjuster's estimate of the building value.

Possible changes: There are no plans for changes to the City's codes. The Oregon State Seismic Safety Policy Advisory Commission has sought legislation requiring that inventories be completed of unreinforced masonry or other earthquake hazardous buildings.

Recommendation 2.4: The City should develop post-disaster building inspection procedures to ensure that all damaged buildings are inspected for both safety and code enforcement purposes. The procedures should:

- " Include training in FEMA's new substantial damage estimator software,
- " Include a public information component to advise property owners of:
 - the code requirements,
 - the need for a permit, and
 - the benefits of retrofitting to avoid future damage.
- " Identify how to obtain additional staff support if needed, and
- " Be sent to the State and FEMA NFIP staff for comment to ensure that they are in compliance with State and NFIP requirements.

4.2.5. Insurance

Insurance has the advantage that, as long as the policy is in force, the property is covered and no human intervention is needed for the measure to work. Damage is not prevented, but the financial impact is mitigated. Often, claims are sufficient to help the property owner to retrofit or otherwise mitigate against a reoccurrence.

There are three types of insurance coverage:

- " The standard homeowner's, dwelling, and commercial insurance policies cover against the perils of wildfire and the effects of severe weather, such as frozen water pipes.
- " Many companies sell earthquake insurance as an additional peril rider on homeowner's policies. Individual policies can be written for large commercial properties. Rates and deductibles vary depending on the potential risk and the nature of the insured properties.
- " Flood insurance. Under the National Flood Insurance Program (NFIP), any insurance agent can sell a separate flood insurance policy under rules and rates set by FEMA. Rates do not change after claims are paid; they are set on a national basis. A recent change to the NFIP, known as "Increased Cost of Compliance," allows payment of up to \$15,000 for certain retrofitting measures that are mandated by the local code for a substantially or repetitively damaged building.

There is no insurance coverage for landslide damage to buildings.

Current implementation: It is not known how many properties are covered by commercial insurance policies. Oregon City joined the NFIP in 1980 in order to make flood insurance available to its residents. However, as of May 1998, there were only 33 policies in the City. Of the 112 buildings in the floodplain, fewer than 22 have a flood insurance policy. Over half of these policies were purchased after the February 1996 flood,

possibly as a condition of receiving disaster assistance. Nine floodplain properties received flood insurance claims from the February 1996 flood.

At last count, there are 11 properties *outside* the floodplain that have flood coverage, most likely for protection from local drainage problems. Two properties outside the floodplain received flood insurance claims from the February 1996 flood.

Low flood insurance coverage is usually due to one or more of the following reasons:

- " People are not aware that their regular insurance policies do not cover flooding,
- " Banks are not requiring flood insurance as a condition of a loan or mortgage for a building in the floodplain (although there may have been few requests for such loans if there is little turnover of property ownership), or
- " Insurance agents are not interested in selling flood insurance.

Possible changes: There are no major changes pending for the NFIP. A federal program for earthquake insurance has been debated for about 20 years. Early action should not be expected.

Recommendation 2.5A: The City should make information on the various types of insurance coverage available to all property owners (see later recommendations on public information). Where possible, this should be undertaken by insurance companies and local insurance agents.

Recommendation 2.5B: City representatives should meet with insurance agents and lenders to help determine the causes for the low level of flood insurance coverage. State and FEMA staff can provide more information, technical assistance and training programs if such activities would help.

4.3. Emergency services

Emergency services measures protect people during and after a disaster. The Fire Chief is Oregon City's emergency manager, responsible for coordinating warning, response, and recovery. He works closely with the Clackamas County emergency manager who is part of the Sheriff's office

4.3.1. Warning

The first step in responding to a disaster is knowing that one is coming. Once the emergency manager learns that a problem is coming, the next step is to notify the public, other agencies and critical facilities. The earlier and the more accurate the warning, the greater the number of people who can seek safety and/or implement protection measures.

Warnings may be disseminated in a variety of ways, including via sirens, radio, television, cable TV, mobile public address systems, telephone trees, and even door-to-door contact. Multiple or redundant systems are most effective: if people do not hear one warning, they may still get the message from another part of the system.

However, the warnings must be clear on what type of hazard is expected and what actions to take. For example, if people think a windstorm or a tornado is coming, they may take shelter in a basement - the worst place to be if the threatening hazard is a flood.

Current implementation:

Floods: The National Weather Service issues flood warnings for the Willamette and Clackamas Rivers at locations where there are river gages. The nearest gage on the Willamette is at Willamette Falls, on the Clackamas it's at Estacada. These warnings are monitored by Clackamas County Emergency Management which alerts others when appropriate. Given the amount of lead time available for these two big rivers, their flood warning system is considered sufficient.

There is no warning system for Abernethy Creek or the other smaller creeks. Their watersheds are so small that a more expensive system of remotely monitored rain and river gages would be needed. The Weather Service did help set one up in eastern Oregon after a flash flood killed some residents.

Landslides: There is no effective advance warning system for landslides, other than the regular forecasts and warnings of severe storms. Sensors in slide-prone areas can alert emergency managers of a slide in progress. The U.S. Geological Survey is experimenting with an advance warning system in California.

Earthquakes: Earthquake warning systems are extremely complicated. Only one such system exists (in southern California). It will only be useful when instruments detect distant motions and are able to communicate warnings a few seconds to a few minutes ahead of their arrival so people can take some protective actions. Warning systems have no value for nearby earthquakes.

Volcanos: Active volcanoes and regions often are instrumented so changes can be monitored and analyzed and warnings issued if needed. These have been useful in preventing casualties, as was shown when Mount St. Helens erupted.

Fire: The Oregon Department of Forestry issues thunder-lightening maps during the high fire season (June - October). The National Weather Service issues fire weather forecasts and "red flag" warnings to federal agencies that own timberland, such as the U.S. Forest Service. Local fire and emergency management offices are usually not connected to this system but they could be over the Internet.

Storms: The National Weather Service has had some recent success in early detection of storms using Doppler radar and other tools. Wind and ice storm warnings are issued by the Weather Service through the NOAA Weather Radio and commercial radio and television stations.

Hazardous materials: There is no remote early detection and warning system for hazardous materials incidents. If a problem occurs, someone calls "911."

Possible changes: The IHMT Report calls for adding gages and upgrading flood forecasting capabilities (page 76). The Weather Service is on a committee with Metro that is looking at where and whether more gages would be needed. The recent *Governor's*

Debris Action Plan calls for developing and implementing an improved warning system for debris flows.

Recommendation 3.1: The City should review the following with the National Weather Service, other agencies involved in warnings, and other communities affected by the same hazards:

- " Whether there should be another river gage on the Clackamas River, closer to Oregon City than Estacada,
- " The costs and benefits of a local flood warning system on Abernethy Creek, and
- " Whether a landslide forecast system could be developed based on monitoring soil saturation and rain forecasts.

4.3.2. Response

Once the warning is received or, in cases where there is no warning, the event has occurred, the emergency management offices respond with actions that can prevent or reduce damage or injury. Such actions (and the responding parties) could include:

- " Search and rescue (police, fire and emergency management staff)
- " Fighting fires (fire department)
- " Activating the emergency operations center (emergency manager)
- " Closing streets or bridges (police or sheriff's department)
- " Shutting off power to threatened areas (utility company)
- " Releasing children from school (school district)
- " Ordering an evacuation (mayor)
- " Opening evacuation shelters (churches, schools, or the Red Cross)
- " Monitoring water levels (engineer)

A local emergency response plan is the best way to ensure that all bases are covered and that the response activities are appropriate for the expected threat. It is developed in coordination with the agencies or offices that are given various responsibilities. Drills and exercises should be conducted to ensure that key participants understand their duties. The result is a coordinated effort implemented by people who have experience working together so that available resources will be used most efficiently.

Current implementation: Both Oregon City and Clackamas County have emergency operations plans. The County's does not have annexes or sections that are hazard specific, i.e., the County plan does not differentiate between the threats of floods, fires, earthquakes, etc.

Oregon City's emergency operations plan was prepared in 1982 and has not been updated since. All contact names, telephone numbers and resource lists are out of date.

The City's plan has hazard specific annexes and a more recent "Hazardous Materials Response Plan." However, these are somewhat brief and generic statements, probably based on a model. They do not include site-specific information or instructions, such as a

list of the hazardous materials storage sites, which bridges will go underwater first during a flood, or what is in the zones of liquefaction or landslide-prone areas.

For example, the flood annex has a statement that the City should consider canceling school during a flood, but does not state which schools are in the floodplain. In fact, there aren't any.

When there is plenty of lead time or when the disaster strikes quickly without warning, the County and City plans can work. However, they do not have specific instructions on how to best respond to a faster moving situation that affects a predicted area, such as a flash flood, landslide or earthquake.

Key to implementing an emergency response plan is an emergency operations center (EOC). This is a facility that is safe from damage and large enough to accommodate the City staff and others who are needed to direct disaster response activities. The EOC needs to be equipped with the communications equipment sufficient to monitor conditions, issue directives to field crews and pass information on to the media and the public.

Oregon City does not have a true EOC. Currently a training room in a fire station is taken over when needed, but it lacks the necessary hazard protection and equipment.

Mandated measures: There are no statutory requirements for city emergency response plan. Counties are required by state law to prepare such plans.

Possible changes: Following the recent floods, landslides and winter storm, the City decided to prepare a new emergency operations plan. A preliminary draft should be ready in time for a special emergency management system training program scheduled for the Spring of 1999.

A new County plan was adopted in August 1997 and the functional annexes are being revised. There are no plans to prepare hazard-specific annexes to the County emergency operations plan.

Recommendation 3.2A: The City should update its emergency operations plan. Staff should obtain more recent plans from other communities and the latest state and national guidelines. The updating should include meetings with the heads of other City departments and other agencies involved in emergency response, such as the County and the Red Cross to ensure that the new plan reflects their capabilities.

0The new plan should include current resource lists and annexes for each of the hazards discussed in this report. It should utilize the latest GIS mapping available and include a flood stage forecast map that relates the potential damage to specific flood forecasts. A list of appropriate response steps should be included for each flood stage level. Additional guidelines can be found in the Community Rating System publications.

Drafting the emergency operations plan should include coordination with other agencies that can help with the various hazards and response activities, such as the Corps of Engineers, the Department of Geology and Mineral Industries (DOGAMI), the Neighborhood Emergency Response Teams, and the recently developed network of amateur radio operators.

Recommendation 3.2B: The City should construct a new emergency operations center. It should be designed and equipped to fulfill the requirements of an EOC during all types of potential disasters.

4.3.3. Dam safety

Large structures that protect areas from flood or landslide hazards can become hazards themselves if they fail. An earthquake or inadequate maintenance can produce a dam failure on short notice on a clear day when no one expects a flood. The resulting flash flood can be more devastating than a slow onset natural flood.

As noted in Chapter 2, a “worst case” failure of all four Portland General Electric (PGE) dams in the Clackamas River watershed would result in a wall of water 60 -80 feet high at Oregon City. The Willamette River and Abernethy Creek both have dams. However, their failure would not result in as great a hazard to the City.

Current implementation: Clackamas County Emergency Management has an Emergency Action Plan for each of the major dams on the Clackamas River and the Willamette Falls Dam on the Willamette River at Oregon City. Precautions include sensors at the dams when they are left unattended and response plans to minimize damage if a dam is threatened with overtopping or failure.

Mandated measures: All dams that could threaten life or property should they fail are regulated, inspected and monitored by the Department of Water Resources’ Dam Safety program. It should be noted that this program has some shortcomings that have kept it from being recognized by FEMA’s Community Rating System.

The power generating dams in the Clackamas watershed must meet the stricter requirements of the Federal Energy Regulatory Commission (FERC). Both programs require dam owners to coordinate with local emergency managers.

Recommendation 3.3.A: The FERC, State and County dam safety programs are designed to prevent a failure and to provide adequate warning if one occurs. As the dams that threaten Oregon City are well outside the corporate limits, there are no dam safety recommendations for the City to implement.

Recommendation 3.3.B: Future land use decisions on development in the Clackamas River floodplain should consider the “worst case” situation. Critical facilities and high occupancy buildings should be avoided in this area.

4.3.4. Critical facilities protection

Critical facilities fall into two categories:

Buildings or locations vital to the emergency response effort:

- " Emergency operations centers
- " Police and fire stations
- " Water mains
- " Hospitals
- " Public works garages
- " Selected roads and bridges
- " Suppliers of needed materials
- " Radio and TV stations and towers
- " Telephone and power substations
- " Evacuation routes

Buildings or locations that, if damaged, would create secondary disasters:

- " Hazardous materials facilities
- " Water treatment plants
- " Wastewater treatment plants
- " Schools
- " Nursing homes
- " Natural gas/oil pipelines

Protecting critical facilities during and after a disaster is a vital part of any emergency services effort. If a critical facility is damaged, workers and resources may be unnecessarily drawn away from their emergency response responsibilities. If such a facility is prepared, it will be better able to support the community's emergency efforts.

Current implementation: Oregon City's 90 critical facilities are plotted on the map in Figure 4-1 at the end of this report. These include:

- 1 hospital
- 3 schools
- 5 public buildings, including the City Hall and fire stations
- 6 hazardous materials facilities
- 11 assisted living homes
- 15 main access roads ("critical arterials")
- 24 churches (often used as shelters during a disaster)
- 25 other places of assembly
- 90

Five of the main access roads would be cut off during a 100-year flood. Six of the facilities (including three hazardous materials facilities) are in the high hazard area north of Abernethy Creek. Eight facilities, mostly places of assembly, are within a block of the bottom of the steep slopes that overlook the First Level downtown area.

Other than the hospital and the schools, it is not known if any of these critical facilities have their own emergency response plan. None of them have a plan that is coordinated with the City's emergency response plan. The City Hall does not have a back up communications system or power supply.

Mandated measures: State law requires hospitals, certain public health facilities, schools, and hazardous materials sites to develop their own emergency plans.

Possible changes: Two recommendations of the IHMT report call for a Governor's executive order on state facilities and mandated flood response plans for public buildings (page 32). Another recommendation says every community should identify emergency access routes (page 36).

Recommendation 3.4: The City should contact each of the identified critical facilities to:

- " Develop a list of contacts and telephone numbers,
- " Determine if they have their own emergency response plans,
- " Determine any special coordination that will be needed during a disaster,
- " Include them in future training programs and emergency drills.

Reminder contacts should be made and the list should be updated at least annually.

4.3.5. Health and safety maintenance

Preventing dangers to health and safety is critical after a disaster. Emergency response plans should identify appropriate measures to take. These include:

- " Controlling traffic and visitors to the affected area(s)
- " Patrolling evacuated areas to prevent looting,
- " Providing safe drinking water,
- " Vaccinating residents for tetanus,
- " Clearing streets, and
- " Cleaning up and disposing of debris and garbage.

Current implementation: The City coordinated the clean up activities following the February 1996 flood and landslides. The Fire Department used its engines to wash down streets, sidewalks and parking lots and to help businesses and home owners clean up their buildings. The clean up effort cost an estimated \$125,000. It included testing of the soils around the solid waste transfer station.

Possible changes: The IHMT Report notes that there is a problem disposing of mud, silt and other debris after a disaster (page 71). It recommends identifying disposal sites before the next disaster. This was a problem in Oregon City, too. The IHMT Report recommends training for local officials on post-disaster health and safety issues (page 80).

Recommendation 3.5: The updated emergency operations plan called for in Recommendation 3.2 should have a post-disaster health and safety maintenance annex which identifies responsible agencies and appropriate procedures. Special attention needs to be paid to controlling traffic and visitors and to clearing, transporting and disposing of debris and garbage.

4.3.6. Recovery and mitigation procedures

These procedures cover those activities that can be taken after a disaster to prepare people and property for the next one. They are implemented during recovery to keep people from immediately going “back to normal” (i.e., the same way they were before the disaster).

These measures include:

- " Evaluating damaged buildings to determine if they can be reentered,
- " Regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations,
- " Public information to advise residents about mitigation measures they can incorporate into their reconstruction work (e.g., using waterproof or fireproof materials, elevating utilities above flood level, and securing large items that will fall during ground shaking),
- " Acquiring substantially or repeatedly damaged properties from willing sellers,
- " Reviewing damaged public facilities for mitigation opportunities,
- " Planning for long term mitigation activities, and
- " Applying for post-disaster mitigation funds.

Current implementation: There are no written procedures that cover these activities. Section 4.3.2 noted the problems with regulating reconstruction after a flood.

Possible changes: Recommendations #5 and #6 on pages 34-35 in the IHMT Report call for statutory authority and developing a pool of trained building inspectors. Recommendation #4 on page 80 recommends training local officials in post-disaster surveying, reconstruction and identifying mitigation opportunities.

Recommendation 3.6: The updated emergency operations plan called for in Recommendation 3.2 should include a post-disaster recovery and mitigation annex with procedures that encourage property owners to incorporate retrofitting and mitigation measures and identifies where outside financial assistance would help.

4.4. Prevention

Prevention measures are designed to keep the problem from occurring or getting worse. They ensure that future development is not exposed to damage by one or more hazards. They are usually administered by planning, building and/or zoning offices.

4.4.1. Land use management

Comprehensive plans, land use plans and zoning ordinances identify how a community should be developed (and where development should not occur). How the land is used can be regulated by these prevention tools.

These tools are most appropriate for preventing development of site-specific hazards, such as flooding, landslides, and wildland/urban interface fires. Use of the land can be tailored to match the land's identified hazards, typically by reserving hazardous areas for parks, golf courses, backyards, wildlife refuges, natural areas, or similar compatible uses.

A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each district. Floodplains, hazardous slopes, natural areas, etc., can be designated as one or more separate or overlay zoning districts that prohibit development or allow only development that is not susceptible to damage.

Appropriate uses in separate zoning districts include public use, conservation, agriculture, and cluster or planned unit developments that keep buildings out of areas that are not appropriate for intensive development. Density of development can also be regulated, such as through formulas that reduce the allowed density on steeper hillsides.

Current implementation: Oregon City has a comprehensive plan and a zoning ordinance. The overlay district approach is used, so the land use map and zoning district map do not reflect the known hazards. The most hazardous floodprone area, the area where the Clackamas joins the Willamette, is set aside in both the plan and the zoning ordinance for the most intensive commercial and industrial development.

Mandated measures: Oregon state law requires every city and county to adopt a comprehensive plan. These plans must be consistent with the state's 19 land use planning goals. Goal 7, "Areas Subject to Natural Disasters and Hazards," calls on communities to evaluate areas subject to natural hazards, to minimize the density or intensity of development in such areas, and to evaluate the beneficial impact on natural resources of allowing events to naturally reoccur.

Metro's Title 3 Model Ordinance identifies "Water Quality Resource Areas," which are closely related to floodplains, as deserving special protection. No structures, construction activities, gardens, lawns, dumping or uncontained hazardous materials would be allowed in such areas. The ordinance also encourages density transfers to reduce the density of floodplain development.

The Water Quality Resource Areas also would likely experience the strongest shaking and possible liquefaction during an earthquake. Prohibiting new buildings in these areas would also have earthquake mitigation benefits.

Possible changes: The IHMT Report calls for communities to develop flood hazard elements for their comprehensive plans (page 47).

Recommendation 4.1.A: The requirements of Metro's Title 3 should be adopted in accordance with Metro procedures.

Recommendation 4.1.B: When the comprehensive plan is next reviewed, this mitigation plan and the State and Metro hazards requirements should be adopted as part of the comprehensive plan. Drafts of the changes should be sent to the appropriate State and Metro offices for review. The Department of Land Conservation and Development can provide technical and, possibly, financial support for this work. When the zoning ordinance is next reviewed, the State and Metro hazards requirements should be incorporated.

Recommendation 4.1.C: The City should work with Metro to develop a map of areas most susceptible to wildland/urban interface fires. Such a map (or more likely a GIS overlay) would greatly facilitate land use plans and development regulations appropriate for the hazard.

4.4.2. Urban Growth Boundary and Urban Reserve Areas

The urban growth boundary (UGB) is a line designated by Metro to restrict urban sprawl, preserve prime farm and forest lands from early development, provide an orderly and efficient transition from rural to urban land use, and encourage in-fill and redevelopment. Metro's policy is to not count undeveloped floodplains, wetlands or slopes steeper than 25% toward a community's buildable land.

The line is expected to delineate all growth areas for 20 years. It has proven to be an effective boundary to contain new urban development.

Beyond the UGB are Urban Reserve Areas. When it is shown that all areas within the UGB have been fully developed, Metro may allow expansion of urban development into these reserves.

Current implementation: The UGB line for Oregon City is shown on the map in Figure 2-5. Most of the undeveloped areas within the line are not subject to a site-specific hazard. The one exception is an area in the northeast that is in the Abernethy Creek floodplain and has some steep slopes.

The largest un- or underdeveloped area affected lies to the south. The UGB line stops short of a large area with steep slopes, so hopefully it will prevent intense development of this hazardous area.

Possible changes: The areas tentatively identified as Urban Reserve Areas do not include any significant areas of floodplains or steep slopes.

Recommendation 4.2: The urban growth boundary rules should be followed and the concept should be supported to benefit all taxpayers of the Portland Metro region. If the City restricts future development in floodprone or steep slope areas, it should request the ability to develop in the urban reserves rather than allow development in hazardous areas.

4.4.3. Land use changes

Planned unit development and subdivision regulations govern local approval of larger developments. These regulations set construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers and drainageways. They can require hazard protection standards on the subdivided lots and the infrastructure such as:

- " Making sure every lot has a buildable area above the flood level,
- " Ensuring that roads are wide enough to allow fire trucks through,
- " Ensuring that roads are high enough to carry emergency vehicles when flooded,
- " Limiting street inclines so they are passable when icy,
- " Requiring stormwater retention basins to reduce flows downstream;
- " Sizing culvert and bridge openings to pass larger flows,
- " Grading and cut and fill limitations on slopes,
- " Preserving vegetative cover on slopes, and
- " Setting earthquake standards for bridges and utility lines.

Current implementation: Larger developments need special permission from the City. These include new subdivisions, shopping centers, planned developments, and industrial and multi-family buildings. Basically, everything other than a platted lot zoned for a single-family home gets an extra review by City planning and engineering staff before construction is permitted. New buildings must still meet the building code standards which are discussed in the next section.

This extra review requires:

- " Conformance of roads and utilities to the City's design manuals,
- " Erosion control measures to minimize the runoff of sediment.
- " A geotechnical review if staff is aware of unstable soils, slopes greater than 25%, high water tables, seismic hazard (based on Metro earthquake hazard maps) or other geological problem, and
- " Stormwater retention basins that meet water quality requirements and that retain up to the 25-year storm and release water at pre-development levels.

City staff feel that the current review requirement is adequate to identify problems and require the applicant to include measures that will prevent damage by floods or landslides. There are no known incidents of such damage to buildings or roads that have been built to these requirements in the last five years. However, staff is not sure the standards are adequate to protect structures not subject to the building code (e.g., roads) from earthquake damage.

Generally, staff depend on the applicant's engineer to identify and address all hazards. The City now has better trained staff to review the technical aspects of the engineering plans. However, they are not sure that there is adequate follow through and inspections to ensure that projects are built according to the approved plans.

Mandated measures: Metro's Title 3 Model Ordinance requires erosion prevention and sediment control measures during construction. This helps preserve the carrying capacity and improves the water quality of the receiving streams and storage basins.

Possible changes: The design manuals are organized by subject, such as water systems, streets, drainage, etc. Some have been adopted and others are in the works. One potential change that arose recently was to allow "skinny streets," i.e., narrower streets that would allow denser development. This was resolved by a recent City Commission decision to ensure that where such streets are considered, additional fire protection measures are incorporated.

Recommendation 4.3: The Departments of Community Development and Public Works should review current and drafted design manuals to ensure that they address all possible hazard provisions. A complete list of possible standards should be developed. It should include the following criteria which have been raised as possible improvements to the current standards:

- " Stormwater retention basins properly located to ensure that they will not be damaged during heavy rains,
- " Requiring retention of runoff from storms larger than the 25-year,
- " Setting development and permit fees high enough to cover the full cost of administering the regulations, especially follow up inspections, and
- " Developing procedures to ensure adequate inspections in time to facilitate corrections of violations.

4.4.4. Building codes

Local building codes must follow the state required code and communities have little freedom to modify them without state approval. However, hazard protection standards for all new and improved or repaired buildings can be incorporated into zoning or other ordinances. These could include hazard mitigation criteria, such as:

- " Ensuring that the foundation will be deep enough to survive a landslide
- " Locating the lowest floor above flood levels,
- " Installing sprinkler systems,
- " Using fire resistant roofing materials, and
- " Designing the structure to withstand expected ice, snow or ash loads and ground shaking.

Current implementation: Oregon City uses the Oregon State Structural Code and the CABO One and Two Family Dwelling Code. The State Code is taken from the national model Uniform Building Code with numerous amendments. The City has made two amendments related to hazards, one on excavation and grading and one on fire sprinklers that make the City's code slightly more restrictive than the State's.

Flood standards: The City has a separate Floodplain Overlay District that, while technically a part of the zoning ordinance, in fact adds building construction criteria. This ordinance (Chapter 17.42) meets the minimum requirements of the National Flood Insurance Program and the State.

The ordinance requires that within the 100-year floodplain shown in Figure 2-1, the lowest floor of all new buildings must be elevated at least one foot above the 100-year or base flood elevation. Nonresidential buildings may be floodproofed to that level. Obstructions and manufactured homes are prohibited from the regulatory floodway, the central and more hazardous portion of the floodplain. Because the floodway in Oregon City is so narrow, this prohibition does not affect many properties.

City staff report that no buildings built to these new flood protection standards have suffered flood damage except for some properties in the high hazard area north of Abernethy Creek. These, including the End of the Oregon Trail Interpretive Center, were hit by flood levels in 1996 higher than the mapped base flood level. The current Flood Insurance Rate Map was adopted in 1979.

Landslide standards: The City has a separate Unstable Soils and Hillside Constraint Overlay District. This ordinance, Chapter 17.44, is also an addition to the zoning ordinance. It governs construction of new buildings and other development that needs a land use permit in the landslide prone areas shown on the map in Figure 2-2.

Before a permit is issued, the applicant must submit an architectural site plan, a soil erosion control plan, a preliminary hydrology report, a preliminary engineering geology report, and a preliminary soil engineering report. The ordinance sets site design, construction, density, stormwater and erosion control standards. There are no known cases of failure of buildings that have been built to the current standards.

Seismic standards: Oregon's Structural Specialty Code contains the state's earthquake design provisions. Local governments either enforce the code directly or it can be done by the state. While local governments can petition to adopt and enforce special code-related programs or measures (e.g., earthquake retrofit standards for unreinforced masonry buildings), this is not an easy or common process. Thus, the adoption process is highly centralized while enforcement is decentralized.

Wildfire standards: The state building code has a provision for "Wildfire Hazard Mitigation" (Appendix Chapter 5, Section 510). This allows the City to designate a "wildfire hazard zone" based on criteria established by the Oregon Department of Forestry. The requirements in such areas relate to roofing materials and street numbering (to facilitate location by fire personnel). Oregon City has not designated any wildfire hazard zones.

Mandated measures: The City's floodplain standards meet the state and NFIP minimum requirements for new buildings in the floodplains. The earthquake criteria are mandated by the State.

Possible changes:

Flood standards: Metro's Title 3 "Water Quality and Floodplain Management Model Ordinance" has additional, more restrictive standards for construction in both the 100-year floodplain and in "water quality resource areas." The latter includes wetlands and undeveloped land within specified distances of certain channels. The latter generally includes areas in floodplains smaller than the FEMA mapped 100-year floodplain.

These additional standards, include:

- " Submitting a plan for mitigating adverse affects of the development,
- " Protecting existing vegetation,
- " Inventorying and removing debris and noxious materials,
- " Revegetating with native species,
- " In larger developments, setting aside the areas as separate undevelopable lots or easements,
- " No net filling and excavation restrictions,
- " A minimum floor elevation of one foot above the base flood or flood of record, whichever is higher, and
- " Restrictions on parking in flood hazard areas.

Landslide standards: The recent studies by Metro and Portland State University identify additional mitigation measures that could be incorporated in a revised ordinance.

Earthquake standards: Because of the off-shore threat of Cascadia Subduction Zone earthquakes, the State Codes Structures Board received a report (February 12, 1998) that would put much of the coastal area in Zone 4 rather than leaving it in Zone 3 (note that these are not the same types of zone as shown in Figure 2-3).

This means that all new buildings would have to be designed with a structural system 33% stronger ("stress capacity") than Zone 3's requirements. Adoption would not affect existing buildings. Should Oregon City's risk zone change, it would be required to follow higher design standards for new construction.

Recommendation 4.4A: State and national floodplain management standards are minimums and do not always protect properties from the type of flooding experienced in Oregon City. The more restrictive standards in Metro's Title 3 Model Ordinance are recommended for adoption.

Recommendation 4.4B: If staff recognizes that the current flood elevations are too low, a higher protection level should be required now, rather than wait for a possible new flood study. The City should consider a freeboard of at least one foot above the current 100-year flood elevation or the flood of record, whichever is higher.

4.4.5. Manufactured housing installation regulations

Manufactured, mobile or modular houses are particularly susceptible to damage because they are lighter and less resistant to natural forces. They can more readily float and they are not very strong when facing high winds. Their lower costs mean that it takes less to substantially damage or “total” a manufactured home.

While they represented only 12% of the total residential units damaged by the 1996 floods and landslides, mobile homes and trailers accounted for 60% of all residential units destroyed (IHMT Report, page 25). Because of these factors, many states and communities have construction or installation regulations specifically for manufactured housing.

Current implementation: Because of the minimum building size required by the building code (1,000 square feet), single wide mobile homes are not permitted in Oregon City outside of a mobile home park. “Double wides” and other types of manufactured housing are permitted.

Chapter 17.42, the City’s Floodplain Overlay District requires elevation above flood levels and tie downs or anchoring to prevent flotation or movement of a flooded manufactured home. It also prohibits manufactured homes in a floodway, except in an existing manufactured home park. (There are no mobile home parks in any of Oregon City’s floodways).

Mandated measures: Elevation and anchoring manufactured housing in the floodplain is an NFIP requirement. The 1997 “Oregon Manufactured Dwelling Standard ” meets the NFIP down requirements for flood protection. It does not have bracing or tie down requirements for earthquake protection, but if they are used voluntarily, they must meet prescribed state standards. Wind bracing requirements are only required along the coast and in the Columbia River Gorge.

Possible changes: The City should continue to enforce the State and NFIP requirements for manufactured housing

Recommendation 4.5: The City should review incorporating bracing or tie down requirements for earthquake protection into the appropriate ordinance (it cannot be included in the building code without state approval).

4.4.6. Open space preservation

Keeping a hazardous area free from development is the best approach to preventing damage from that hazard. Land use and capital improvement plans identify areas to be preserved by acquisition and other means, such as purchasing an easement. With an easement, the owner is free to develop and use private property, but property taxes are reduced or a payment is made if the owner agrees to not build on the hazardous part or the part set aside in the easement.

Open space lands and easements do not always have to be purchased. Developers can be required to dedicate park land and easements. These are usually floodplains or areas subject to landslides. Maintenance easements also can be provided by streamside property owners in return for a community channel maintenance program.

Current implementation: The City requires subdivisions and larger developments to set aside land for stormwater retention. Metro has been purchasing undeveloped land in the steep slope area in the west hills overlooking Newell Creek. These regulations and purchases have prevented construction on the most hazardous slopes in the Newell Crest subdivision, even after streets were built and lots had been platted.

Possible changes: Metro's Title 3 "Water Quality and Floodplain Management Model Ordinance" prohibits new buildings and other types of development in "water quality resource areas." The latter includes wetlands, and undeveloped land within specified distances of certain channels. Separate lots would have to be deeded to a governmental unit or set aside as an easement, effectively preserving such areas as open space.

Recommendation 4.6A: Procedures to review subdivision and other large development proposals should ensure a review to identify hazardous areas in addition to the water quality resource areas. Such areas should be set aside, either for donation by the developer or as prime spots for Metro acquisition.

Recommendation 4.6B: The proposed Title 3 "water quality resource area" language should be adopted by the City.

4.4.7. Forestry and agricultural practices

Forestry and agricultural practices can prevent certain types of damage from storms, floods, landslides, and fires:

- " Cutting back or preventing the growth of ivy that kills trees and destroys the root system that helps to hold hillside soils in place.
- " Cutting back tree limbs and growth that may fall on power lines and houses during wind or ice storms,
- " Crop farming practices that minimize the runoff and erosion from the bare land,
- " Cutting back dead or dry brush near houses on the wildland/urban interface to reduce the wildfire hazard, and
- " Forestry practices that avoid clear cutting, minimize the potential for forest fires, and minimize the runoff and erosion from the bare land.

Current implementation: Natural activities are not regulated or managed by City or County ordinances. There are no programs to cut back ivy or trees or inform property owners of the benefits of such practices.

The State Department of Forestry can prohibit timber harvesting or road building where there is a potential for landslides that pose a significant threat to human lives. As of April 1998, the Department had stopped 43 operations under this authority. More operations were stopped voluntarily by the owners.

Electric utilities are required to have a program that maintain a minimum clearance between vegetation and power lines. As private entities, the utilities sometimes have difficulties due to the owners' attachment to trees, property rights issues, and liability concerns.

Possible changes: Three recommendations on pages 58 - 61 of the IHMT Report call for improved watershed planning support and monitoring forest and agricultural practices to determine their impact on runoff and downstream flooding and landslides.

Recommendation 4.7.A: The City should seek technical assistance from the State Department of Forestry and/or the U.S. Forest Service to develop guidance materials on appropriate practices for the ivy and trees in the City. Such practices should be publicized to encourage people to implement them to protect their own properties (see later recommendations on public information).

Recommendation 4.7.B: The City should inventory streets and other public facilities that may be threatened by landslides. If their risk is increased because of ivy, City staff should take appropriate preventive measures to reduce the risk.

Recommendation 4.7.C: The City should contact the Soil and Water Conservation District to determine the potential for increased flooding due to farming and forestry practices in the watershed. If there is a problem, the City should encourage appropriate federal, state and regional agencies to help initiate safer agricultural and forestry practices.

4.5. Public information

Public information activities advise property owners, potential property owners and visitors about the hazards and ways to themselves and their property from the hazards. They are usually implemented by a public information office.

4.5.1. Hazard information

Many people are not aware of the hazards they face. Many times, even if they want to find out about their exposure, accurate technical data may not be available.

Current implementation: The Flood Insurance Rate Map for the City is available for free. Common users are insurance agents and banks. The City's GIS system has maps and data on:

- " The 100-year floodplain shown on FEMA's Flood Insurance Rate Map,
- " The area flooded in February 1996, as recorded by the U.S. Army Corps of Engineers,

- " Areas of steep slopes as identified by the City's analysis of elevation data,
- " Areas of seismic hazards as identified by the Department of Geology and Mineral Industries,
- " Wildland/urban interface fire hazard areas, and
- " Sites with hazardous materials reported under the SARA Title III rules.

Availability of these maps are not generally publicized as City staff are not sure of the resulting workload or the amount of time it would take to explain the data to inquirers.

Possible changes: There are no plans to change current practices.

Recommendation 5.1: The City should publicize that it has general hazard data for any address. Staff should develop generic handouts that explain the data, its shortcomings, and how to obtain more accurate data on any particular site. The handouts should also describe appropriate protection and retrofitting measures and where more information on them can be obtained.

This approach would provide important information to any interested citizen or business with a minimum staff workload. The draft handouts should be reviewed by the city attorney to ensure that the information does not mislead readers.

4.5.2. Outreach projects

Outreach projects are a proactive approach to public information. They reach out to people and give them information, even when they do not ask for it. They can cover a variety of topics, such as the hazard, insurance, ways to prevent or reduce damage, warning procedures, and construction regulations. Outreach projects are designed to encourage people to seek out more information and take steps to protect themselves and their properties.

There are many types of outreach projects. They can include:

- " Mass mailings or newsletters to all residents
- " Notices directed to residents of hazardous areas
- " Displays in public buildings, shopping malls, etc.
- " Newspaper articles and special sections
- " Radio and TV news releases and interview shows
- " A detailed property owner handbook tailored for local conditions
- " Presentations at meetings of neighborhood groups

Research has proven that outreach projects work. However, awareness of the hazard is not enough; people need to be told what they can do about it, so projects should include information on property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns. Therefore, outreach projects should be locally designed and tailored to meet local conditions.

The NFIP's Community Rating System credits community outreach projects related to flood protection. Credit is given for annual outreach projects to all residents, projects

directed at floodplain residents and for developing a public information program strategy that identifies the most appropriate additional outreach projects for the local situation.

Current implementation: The City has access to the following media that could be used for outreach projects:

- " *Trail News*, the City's monthly newsletter that goes out with all water bills,
- " *Oregon City News*, a commercial newspaper that is distributed every week to subscribers,
- " *The Oregonian*, the Portland metro daily newspaper,
- " Newsletters published by the Chamber of Commerce and various businesses,
- " Targeted mailings to selected areas of the City,
- " Meetings of the ten neighborhood associations,
- " *Willamette Falls Cable* reader board, and
- " Training seminars held with the Neighborhood Emergency Response Teams.

There are no programs to publicize hazard information, although the Fire Department has had newsletter articles on fire prevention and safety.

Possible changes: The IHMT Report recommends creation of a flood mitigation education program to be managed by state agencies (page 79). The program could include public workshops, educational TV programs and a curriculum for grade schools.

Recommendation 5.2: The City should establish a public information program strategy team following the guidelines of the Community Rating System. The team would develop the most appropriate outreach and educational projects for the City. The strategy should:

- " Capitalize on materials developed by and activities conducted by regional, state and federal programs,
- " Publicize appropriate retrofitting measures (as per Recommendation 2.2),
- " Publicize appropriate information on local site improvements (as per Recommendation 2.3),
- " Include a post-disaster component that covers clean up, repairs and reconstruction permit requirements (as per Recommendation 2.4),
- " Explain available hazard insurance (as per Recommendation 2.5),
- " Explain appropriate forestry practices (as per Recommendation 4.7.A),
- " Publicize available hazard maps and data (as per Recommendation 5.1), and
- " Publicize the City's technical assistance services (as per Recommendation 5.3).

4.5.3. Technical assistance

Property owners usually implement their own property protection measures. However, measures to encourage and assist owners can be implemented at the community level. Technical assistance can be provided in one-on-one sessions with property owners.

Community officials can provide advice and information on matters such as identifying the hazards at the site, correcting local problems, retrofitting, dealing with contractors, and funding.

Current implementation: The City has no formal program for technical assistance to property owners. Building inspectors have provided help when asked. In one case, an apartment complex owner put in retaining walls. In another case, the person advised did nothing and the building was damaged by a landslide three years later.

Possible changes: There are no plans for changes to the current procedures.

Recommendation 5.3: City staff should become knowledgeable about appropriate retrofitting, site improvement and protection techniques. The availability of technical assistance should be publicized. The resulting protection activities would be installed and financed by the owners, resulting in hazard mitigation measures implemented at little cost to the City.

4.5.4. Real estate disclosure

Many times after a flood, people say they would have taken steps to protect themselves if only they had known they had purchased a floodprone property. Often disclosure does not stop a sale. In fact, research has found that it does not usually affect the sale price. However, disclosure gives buyers an opportunity to negotiate a purchase price that would reflect the cost of retrofitting, insurance, or other needed protection measure.

Current implementation/Mandated measures: Oregon State law requires property sellers to disclose all known defects of the property. The seller and buyer sign a disclosure form that identifies hazards known by the seller. The form recommended for use by the Portland Metropolitan Association of Realtors® lists the following:

- A. Are you aware of any settling, soil, standing water or drainage problems on the property or in the immediate area?
- B. To your knowledge, does the property contain fill?
- C. Are you aware of any material damage to the property or any of the structure from fire, wind, floods, beach movements, earthquake, expansive soils or landslides?
- D. To your knowledge, is the property in a designated floodplain?
- E. To your knowledge, is the property in a designated slide zone?

Real estate agents help ensure that their clients meet this requirement. There have been successful lawsuits against both sellers and real estate agents. Certain sellers are exempt from this requirement, e.g., an absentee landlord who has no first hand knowledge about site conditions.

It should be noted that this requirement is keyed to problems known to or experienced by the seller. It does not require disclosure of possible hazards, such as potential damage due to an earthquake or presence of nearby hazardous materials, if the seller is not aware of them. It does not require anyone to check maps of floodplains or slide zones.

Federally regulated lending institutions must advise applicants for a mortgage (or other loan that is to be secured by a building) whether the property is in a floodplain as shown on the Flood Insurance Rate Map (approximately the same as the area shown in Figure 2-1). This requirement has to be met five days before closing.

Possible changes: The IHMT Report calls for stronger disclosure laws (page 54).

Recommendation 5.4: There is no single brochure or handout that advises property buyers about the variety of possible hazards and where to get more information about a site's exposure. The City should prepare one that would be given to all house hunters. It should be prepared in cooperation with Metro and local real estate agencies

Chapter 5. Action Plan

The approach recommended in this plan is for the City of Oregon City to pursue the goals and objectives listed in Chapter 3 with a five pronged approach:

1. Establish an overall mitigation program for the City.
2. Develop a comprehensive multi-hazard emergency response program.
3. Implement specific mitigation projects on sites that affect public health and safety.
4. Incorporate mitigation measures into new development.
5. Provide information and assistance to residents and businesses.

These five general themes are translated into actions in this Chapter. Each action item has a lead agency responsible for ensuring that it will be implemented. The justification and supporting information for each item are located in the referenced recommendation(s) from Chapter 4.

5.1. Establish an overall mitigation program for the City.

Action 5.1.1. Adopt this Hazard Mitigation Plan.

Lead agency: City Commission

Deadline: October 31, 1998

Action 5.1.2. Create a standing Mitigation Coordinating Committee.

The Community Planning Team that developed this plan should be formally designated as a standing Mitigation Coordinating Committee. The Committee should be charged with:

- " Coordinating the implementation of this Plan
- " Monitoring progress in implementing the Plan,
- " Setting priorities among competing action items,
- " Submitting an annual report to the City Commission on progress,
- " Recommending changes needed to this plan as part of the annual report, and
- " Inculcating a "think mitigation" attitude in City activities.

Lead office: City Commission

Deadline: October 31, 1998

Action 5.1.3. Develop a detailed mitigation plan for the northeastern part of the City.

This area is delineated in Figure 5-1. It is the most hazardous area in Oregon City, subject to:

- " Flooding from all three streams,
- " The most severe damage due to a dam failure,
- " Earthquake Zone A,
- " A landslide that could cut West Linn's main water supply, and
- " Three of the City's six hazardous materials sites.

This area was the worst hit in the February 1996 flood. It also has much open space that has been eyed for development.

Lead office: Department of Community Development

Supporting offices: Mitigation Coordinating Committee, U.S. Army Corps of Engineers (see action item 5.3.3), Natural Resources Conservation Service, National Weather Service. Possible funding for the plan may be available under Oregon Emergency Management's Flood Mitigation Assistance Program.

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.1

Recommendations (from Chapter 4): 2.1, 3.3.B

Action 5.1.4. Apply for participation in the CRS.

Participation in the National Flood Insurance Program's Community Rating System (CRS) provides a national recognition of the City's flood mitigation efforts, reduces flood insurance premiums for residents, and encourages the City to continue to implement flood hazard mitigation and public information programs during dry periods. This program is referenced under several mitigation measures in Chapter 4. It is explained in more detail in Appendix A.

Lead office: Department of Community Development

Supporting offices: FEMA, Insurance Services Office

Deadline: 1 year from adoption of the Mitigation Plan

Recommendations (from Chapter 4): The CRS can provide credit for implementing recommendations 1.4A, 1.4C, 2.1, 2.2A, 2.3, 2.4, 2.5A, 3.2A, 3.3B, 3.4, 4.1A, 4.1 B, 4.3, 4.4A, 4.4B, 4.6B, 5.1, 5.2, 5.3, and 5.4.

[This page reserved for Figure 5-1,
the map showing the multi-hazard area where the three streams converge.

Replace this page with the map.

Be sure to print page 5 - 4 on the back side.]

5.2. Develop a comprehensive multi-hazard emergency response program.

Action 5.2.1. Revise the emergency response plans.

The emergency response plans and operations procedures should be reviewed and updated to include hazard-specific actions and post-disaster mitigation activities.

Lead office: Fire Department

Supporting offices: Clackamas County Emergency Management, Oregon Emergency Management. Metro and other communities could provide support by developing model procedures for post-disaster mitigation activities.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.1, 1.3, 1.4

Recommendations (from Chapter 4): 2.4, 3.2A, 3.4, 3.5, 3.6

Action 5.2.2. Improve the hazard warning systems.

Staff should review the current and possible early warning systems with Clackamas County Emergency Management and the National Weather Service. These systems should relate to all hazards where advance notice is feasible: flooding, dam failure, landslides, volcanic activity, severe storms, and wildland/urban interface fires.

Lead office: Fire Department

Supporting offices: Clackamas County Emergency Management, Oregon Emergency Management, National Weather Service, Department of Forestry, Department of Water Resources (dam safety office), U.S. Geological Survey.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.1, 1.2, 1.4,

Recommendations (from Chapter 4): 3.1, 3.3.A

Action 5.2.3. Coordinate with critical facilities.

Contact should be made with each critical facility that is exposed to one of the identified hazards to initiate warning, response planning, other emergency management coordination needs. This should be done pursuant to the priority system in Action 5.3.2.

Lead office: Fire Department

Deadline: 3 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.2, 1.3, 1.4, 3.2, 3.4, 3.5

Recommendations (from Chapter 4): 3.2A, 3.2B, 3.4

Action 5.2.4. Develop post-disaster inspection procedures.

Procedures should be developed so after a disaster inspectors can quickly determine which buildings are safe to reenter and which ones have potential for acquisition or incorporating retrofitting projects during reconstruction.

Lead office: Department of Community Development

Supporting offices: Department of Land Conservation and Development (floodplain programs), FEMA. Metro and other communities could provide support by developing model procedures for post-disaster building inspection procedures.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.2, 3.2, 3.4

Recommendations (from Chapter 4): 2.4, 3.5, 3.6

5.3. Implement specific mitigation projects on sites that affect public health and safety.

Action 5.3.1. Conduct a hazard analysis and risk assessment of priority facilities.

The assessment should be initiated for the following top priority critical facilities. Plans should be prepared to mitigate the hazards they are exposed to.

- " City Hall
- " Fire Station 2
- " Hospital

Lead office: Department of Community Development

Supporting offices: Fire Department

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.3, 3.2, 3.3

Recommendations (from Chapter 4): 2.2A, 3.4

Action 5.3.2. Develop a mitigation planning priority system.

An objective system would prioritize mitigation planning for other facilities and sites not listed in the previous action item. An example of the kind of information that could be

considered is included in Appendix B. The owners should be contacted to review the possibilities for and interest in mitigation activities to reduce the exposure to damage.

Lead office: Mitigation Coordinating Committee

Supporting offices: Department of Community Development (GIS office)

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.1, 3.2, 3.3

Recommendations (from Chapter 4): 1.2, 2.2B, 3.4, 4.7.B

Action 5.3.3. Pursue flood protection alternatives for the three streams.

The Willamette and Clackamas Rivers and Abernethy Creek present the major flood hazard. City staff should meet with the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, Metro and others to determine if funding and technical support for flood control and flood warning alternatives are feasible. If a flood control project for the entire floodplain is not feasible, agencies should review the feasibility of a project that just protects the businesses south of Abernethy Creek.

Lead office: Department of Community Development

Supporting offices: U.S. Army Corps of Engineers, Natural Resources Conservation Service, National Weather Service

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.1, 3.1, 3.2

Recommendations (from Chapter 4): 1.1.A, 1.1.B, 3.1

Action 5.3.4. Prepare a formal drainage maintenance program.

A written drainage maintenance program would clarify procedures and assess the needed level of maintenance. If what is needed proves to be beyond current resources, staff should review whether an increase in the utility fees is appropriate.

Lead office: Department of Public Works

Supporting offices: The Community Rating System has a model program that identifies how the local program can maximize CRS credit.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.3

Recommendations (from Chapter 4): 1.4.A, 1.4.B]

Action 5.3.5. Continue the detailed drainage studies for the remaining basins.

Lead office: Department of Community Development

Deadline: 5 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.1

Recommendations (from Chapter 4): 1.3

Action 5.3.6. Identify appropriate practices for maintaining ivy and trees.

A written set of procedures is needed to minimize damage from wildfires, erosion, and downed power lines.

Lead office: Department of Public Works

Supporting offices: Department of Forestry, U.S. Forest Service “Friends of Trees.”
Metro and other communities could provide support by developing model maintenance procedures.

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 2.4, 3.2, 3.3, 3.4

Recommendations (from Chapter 4): 4.7.A, 4.7.C

5.4. Incorporate mitigation measures into new development.

Action 5.4.1. Ensure that high hazard areas are avoided.

Staff should review the comprehensive plan, zoning ordinance and urban growth boundary requirements in light of the mapped hazards.

Lead office: Department of Community Development

Supporting offices: Department of Land Conservation and Development (technical assistance and possible funding support), Metro.

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 2.1

Recommendations (from Chapter 4): 3.3.B, 4.1.B, 4.2, 4.6.A

Action 5.4.2. Set appropriate development standards.

The design standards and criteria for land divisions and other large developments should be reviewed and revised to include:

- " Required geo-technical investigations
- " A requirement for fuel breaks for those developments near forested areas.
- " Protection from known flood hazards, even if higher than the FEMA mandated 100-year flood
- " Stormwater retention standards
- " Updating administrative matters, such as fees and inspections
- " Recommendations in Metro's model ordinances

Lead office: Department of Community Development

Supporting offices: Department of Public Works, Fire Department

Supporting offices: Metro and other communities could provide support by developing model design standards for the area.

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 2.1, 2.2, 2.4

Recommendations (from Chapter 4): 1.5, 3.3.B, 4.3, 4.4.B, 4.6.A

Action 5.4.3. Update the standards for individual buildings.

The current building code and floodplain management regulations should be reviewed and revised in light of the known hazards and recommendations from Metro's mitigation plan.

Lead office: Department of Community Development

Supporting offices: Fire Department, Oregon Building Codes Division, Department of Forestry. The Community Rating System has model ordinance language that identifies how the local program can maximize CRS credit.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 2.2, 2.3

Recommendations (from Chapter 4): 4.1.A, 4.4.A, 4.4.B

5.5. Provide information and assistance to residents and businesses.

Action 5.5.1. Develop a public information strategy.

The strategy should build on existing public and private public information programs and capitalize on direct person to person contacts, such as through the neighborhood associations and the Neighborhood Emergency Response Teams. Guidance on preparing a public information strategy is found in the Community Rating System publications. The strategy should be designed to inform property owners, businesses and potential property owners about:

- " The hazards they face
- " How they can best prevent problems
- " How they can protect themselves
- " How they can protect their properties
- " What insurance is available
- " Permit requirements

Lead office: Mitigation Coordinating Committee

Supporting offices: Department of Community Development, Fire Department, Department of Public Works, Clackamas County Emergency Management, Department of Geology and Mineral Industries, Department of Land Conservation and Development, Department of Forestry, Oregon Emergency Management, FEMA, National Weather Service, U.S. Forest Service, American Red Cross. Metro and other communities could provide support by developing a regional and/or model local public information strategy. The Community Rating System has example outreach programs that identify how the local program can maximize CRS credit.

Deadline: 1 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 1.2, 3.4

Recommendations (from Chapter 4): 1.4.C, 2.2A, 2.3, 2.4, 2.5.A, 3.6, 4.7.A, 5.1, 5.2, 5.3

Action 5.5.2. Pursue funding for mitigation.

Staff should pursue funding sources for the mitigation activities instituted pursuant to section 5.3.

Lead office: Department of Community Development

Supporting offices: Oregon Emergency Management, FEMA. Metro could provide support by developing a master list of appropriate funding programs.

Deadline: 2 year from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.1, 3.4, 3.5

Recommendations (from Chapter 4): 2.1, 2.2A, 2.2B, 2.3

Action 5.5.3. Improve hazard insurance coverage.

Work with insurance agents to determine what can be done to increase the amount of flood and earthquake insurance coverage.

Lead office: Department of Community Development

Supporting offices: Department of Land Conservation and Development, FEMA. Metro and other communities could provide support by working with regional organizations of insurance agents and sponsoring area-wide training sessions.

Deadline: 2 years from adoption of the Mitigation Plan

Objectives (from Chapter 3): 3.4

Recommendations (from Chapter 4): 2.5.B

5.6. Summary of priority steps

This Chapter's Action Plan identifies 20 action items to be implemented by five different lead offices. Not everything can be started at once. Therefore, this section reviews the recommended first steps:

1. The City Commission adopts this mitigation plan and establishes the Mitigation Coordinating Committee (action items 5.1.1 and 5.1.2). This would be done by resolution in October.
2. As chair of the Mitigation Coordinating Committee, the Fire Chief, meets with Metro to identify which action items deserve regional attention. This would be done in October.
Possible regional action items include:
 - Model procedures for post-disaster mitigation activities (action item 5.2.1)
 - Model procedures for post-disaster building inspection procedures (5.2.4)
 - Funding and technical support for flood control and flood warning(5.3.3)
 - Model ivy and tree maintenance procedures (5.3.6)
 - Model development design standards that account for area hazards (5.4.2)
 - Regional and/or model local public information strategy (5.5.1)
 - Master list of appropriate funding programs (5.5.2)
 - Regional efforts to improve insurance coverage (5.5.3)
3. In October, the Department of Community Development contacts the Oregon Office of Emergency Management to determine funding possibilities under the Flood Mitigation Assistance program for:

- A detailed mitigation plan for the mitigation target area (action item 5.1.3), or
- Elevating and retrofitting floodprone buildings (action item 5.5.2).

At the same time, the Department contacts the U.S. Army Corps of Engineers and the Natural Resources Conservation Service about the timing and procedures for a flood control study on the three major streams (action item 5.3.3). If one of the agencies can do a preliminary reconnaissance study on Abernethy Creek, it may be better to conduct the mitigation plan for the target area after the flood study determines the likelihood of a flood control project.

4. The Mitigation Coordinating Committee holds its first meeting in November. Each lead office reports on the progress toward its assigned action items. The Committee establishes a regular meeting schedule and verifies the priority projects, based on the timing of expected support from Metro, the Corps and other agencies.
5. During November or December, the Fire Chief and a representative of the Department of Community Development meet with the ISO/CRS Specialist for Oregon to review the procedures and creditable activities of the Community Rating System (action item 5.1.4). Whether the City applies to the CRS or not, guidance materials are ordered to assist in preparation of:
 - Drainage system maintenance procedures (action item 5.3.4)
 - Flood protection regulatory standards (5.4.3)
 - Public information program strategy (5.5.1)
6. During November through March, the Fire Department prepares a preliminary revised emergency operations plan (action items 5.2.1, 5.2.2, and 5.2.3). The preliminary plan is circulated for cooperating agencies to review. It is used at a week long exercise to be hosted by FEMA in March. It is revised as needed based on the comments from reviewers and the exercise findings.
7. In December or January, at its second meeting, the Mitigation Coordinating Committee decides on the priority projects for the rest of this fiscal year. In particular, the Committee needs to determine when and how to conduct the study of the mitigation target area (action item 5.1.3) and the site-specific studies (5.3.1 and 5.3.2).
8. In December or January, upon receipt of the CRS guidance materials, the Department of Public Works drafts formal drainage system maintenance procedures based on current practices and desired improvements to those practices.
9. In December or January, as part of their budget preparations for the next year, the departments identify the expected costs of implementing the remaining action items assigned to them, including:

Department of Community Development:

- Assembling the application to the Community Rating System (action item 5.1.4)

- Developing post-disaster building inspection procedures (5.2.4)
- Conducting risk assessments of priority facilities (5.3.1 and 5.3.2)
- Flood protection planning (5.3.2)
- Continued implementation of the master drainage plan (5.3.5)
- Revising the comprehensive plan and development ordinances to incorporate hazard mitigation criteria (5.4.1, 5.4.2 and 5.4.3)
- Developing a City public information strategy (5.5.1)

Fire Department

- Completing the emergency response plan (5.2.1)
- Pursuing improved hazard warning systems (5.2.2)
- Contacting and formalizing relations with critical facilities (5.2.3)

Appendix A. The Community Rating System

A.1. Background

The Community Rating System (CRS) provides a flood insurance premium rate reduction for communities that implement activities above and beyond the minimum requirements of the National Flood Insurance Program. The CRS provides credits for a variety of community flood protection activities, organized under four general series:

300	Public information
400	Mapping and regulatory activities
500	Flood damage reduction
600	Flood preparedness

To receive a 5% or 10% CRS flood insurance premium reduction, a community applies to the Federal Emergency Management Agency. This involves application worksheets and presentation of appropriate documentation. FEMA sends a CRS Specialist from the Insurance Services Office, Inc. (ISO). The ISO/CRS Specialist visits the community and verifies that the activities are being implemented as described in the application.

The community is given points based on the ISO/CRS Specialist's evaluation and verification of the activities. In some cases, additional points are provided for activities that are implemented on a regional or state level. The ISO/CRS Specialist is kept abreast of any changes in the Community's program and conducts periodic visits to verify continued implementation.

A.2. Benefits

If the community does not have many flood insurance policies in effect, there would be a relatively low direct financial benefit from participating in the CRS. However, more residents should have flood insurance, especially if the community implements the recommended public information programs. The more policies sold, the more people would benefit from the community's flood program, even when it doesn't flood.

More importantly, there are some nonfinancial benefits to the CRS:

- " The CRS flood hazard mitigation activities provide enhanced public safety, a reduction in damage to property and public infrastructure, avoidance of disruption and losses, reduction of human suffering, and protection of the environment.
- " A community can evaluate the effectiveness of its flood program against a nationally recognized benchmark. Currently, 14 Oregon communities participate. There are approximately 900 communities participating nationally.

- " Technical assistance in designing and implementing some activities is available at no charge from ISO.
- " A CRS community's flood program benefits from having an added incentive to maintain its flood programs over the years. The fact that the community's CRS status could be affected by the elimination of a flood-related activity or a weakening of the regulatory requirements for new development, should be taken into account by the governing board when considering such actions. A similar system used in fire insurance rating has had a strong impact on the level of support local governments give to their fire protection programs.
- " Implementing some CRS activities, such as flood hazard mitigation planning, can help a community qualify for certain federal assistance programs.

In other words, the CRS encourages communities to keep their flood programs going during times of drought and lack of interest. This would be the greatest benefit to the floodprone residents of a floodprone community.

A.3. Activities

There are 18 activities organized under 4 series. The following list summarizes the activities and the average number of points that communities have received for them. Each 500 points brings a better CRS class and an additional 5% premium rate reduction.

Public Information Activities (Series 300)

310 (Elevation Certificates) Maintain FEMA elevation certificates for all new construction after the date of CRS application. This is a minimum requirement for any CRS credit. (72)

320 (Map Information) Respond to inquiries to identify a property's FIRM zone and publicize this service. (138)

330 (Outreach Projects) Send information about the flood hazard, flood insurance, and flood protection measures to floodprone residents or all residents of the community. (81)

340 (Hazard Disclosure) Real estate agents advise potential purchasers of floodprone property about the flood hazard; or regulations require a notice of the flood hazard. (24)

350 (Flood Protection Library) The public library maintains references on flood insurance and flood protection. (22)

360 (Flood Protection Assistance) Give inquiring property owners technical advice on how to protect their buildings from flooding and publicize this service. (57)

Mapping and Regulatory Activities (Series 400)

410 (Additional Flood Data) Develop new flood elevations, floodway delineations, wave heights, or other regulatory flood hazard data for an area that was not mapped in detail by the flood insurance study; or have the flood insurance study's hydrology or allowable floodway surcharge based on a higher state or local standard. (148)

420 (Open Space Preservation) Guarantee that a portion of currently vacant floodplain will be kept free from development. (206)

430 (Higher Regulatory Standards) Require freeboard; require soil tests or engineered foundations; require compensatory storage; zone the floodplain for minimum lot sizes of 1 acre or larger; regulate to protect sand dunes; or have regulations tailored to protect critical facilities or areas subject to special flood hazards (e.g., alluvial fans, ice jams, or subsidence). (159)

440 (Flood Data Maintenance) Keep flood and property data on computer records; use better base maps; or maintain elevation reference marks. (78)

450 (Stormwater Management) Regulate new development throughout the watershed to ensure that post-development runoff is no worse than pre-development runoff. (122)

Flood Damage Reduction Activities (Series 500)

510 (Floodplain Management Planning) Prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan using a standard planning process. (34)

520 (Acquisition and Relocation) Acquire and/or relocate floodprone buildings so that they are out of the floodplain. (177)

530 (Retrofitting) Document floodproofed or elevated pre-FIRM buildings. (66)

540 (Drainage System Maintenance) Conduct periodic inspections of all channels and retention basins and remove debris as needed. (236)

Flood Preparedness Activities (Series 600)

610 (Flood Warning Program) Provide early flood warnings to the public and have a detailed flood response plan keyed to flood crest predictions. (99)

620 (Levee Safety) Maintain levees that are not credited with providing base flood protection. (153)

630 (Dam Safety) All communities in a state with an approved dam safety program receive credit. (no points in Oregon)

More information on the Community Rating System can be obtained from:

NFIP/CRS
P.O. Box 501016
Indianapolis, IN 46250-1016

317/848-2898 (phone)
317/848-3578 (fax)
wtrakimas@iso.com

Or from the ISO/CRS Specialist for Oregon:

Rob Flaner
Insurance Services Office, Inc.
90 South Blackwood Ave.
Eagle, ID 82616

208/939-4432 (phone and fax)
rflaner@iso.com

Appendix B. Mitigation Planning Priority System

Section 4.3.4 lists 90 critical facilities in Oregon City. These range from roads to buildings to hazardous materials facilities. There are other sites that also merit mitigation attention. For example, the Department of Public Works has identified 15 key bridges that need to be kept open for emergency traffic.

In short, the City is faced with many places that could use attention. To ensure that the most important ones are tackled first, a planning priority system is needed. Such a system could be developed relatively easily with existing data and the City's Geographic Information System (GIS).

Here's how such a system could work:

1. Review the following items and determine the number of points each deserves. The following points are proposed, but the Community Planning Team should confirm that they reflect City priorities.

<u>Points</u>	<u>Item</u>	<u>Hazard</u>
2	Floodplain	
2	Landslide: areas within 100' of a 25% slope (to pick up properties that may be covered by a slide or may slide downhill with the slide)	
3	Earthquake zone A	
2	Earthquake zone B	
1	Earthquake zones C or D	
		<u>Transportation</u>
5	Bridge across the Clackamas or Willamette Rivers	
3	Other critical arterial (from critical facilities map), railroad	
3	Major utility lines	
		<u>Critical facilities</u>
5	Hospital	
5	Fire station	
3	Other public building, water treatment plant, etc.	
3	School	
3	Hazardous materials site	
2	Assisted living home	
1	Other critical facilities (churches, apartments)	

2. Plot the above items on a GIS overlay.

3. The software can add the points for each site. Provide the total score for each lot. Consider a bridge as a lot. Consider a length of road as a lot.
4. Plot the scores. A color code could be used, e.g., red for 10+, orange for 8 - 10, etc.
5. Develop mitigation plans for the highest scoring sites first. Where several sites are grouped together, it could be more cost effective to address the area, instead of waiting for each site to come up on the priority list.